THE ELECTRICAL WORLD

A Weekly Review of Current Progress in Electricity and its Practical Applications

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Historical Electric Motors.

The electric motor appears to have been one of the first conceptions of those who sought to apply electricity to industrial uses in the early part of the present century. At that time steam had scarcely been put to any use, and by many the possibilities which lay before it were unthought of. A motor operated by the agency of electricity seemed to be, therefore, the greatest boon of the age. The law of the conservation of energy was almost unknown; the relations between the energy of chemical affinity and other forms were almost entirely unsuspected, and it is not a good deal of the attention which had been concentrated

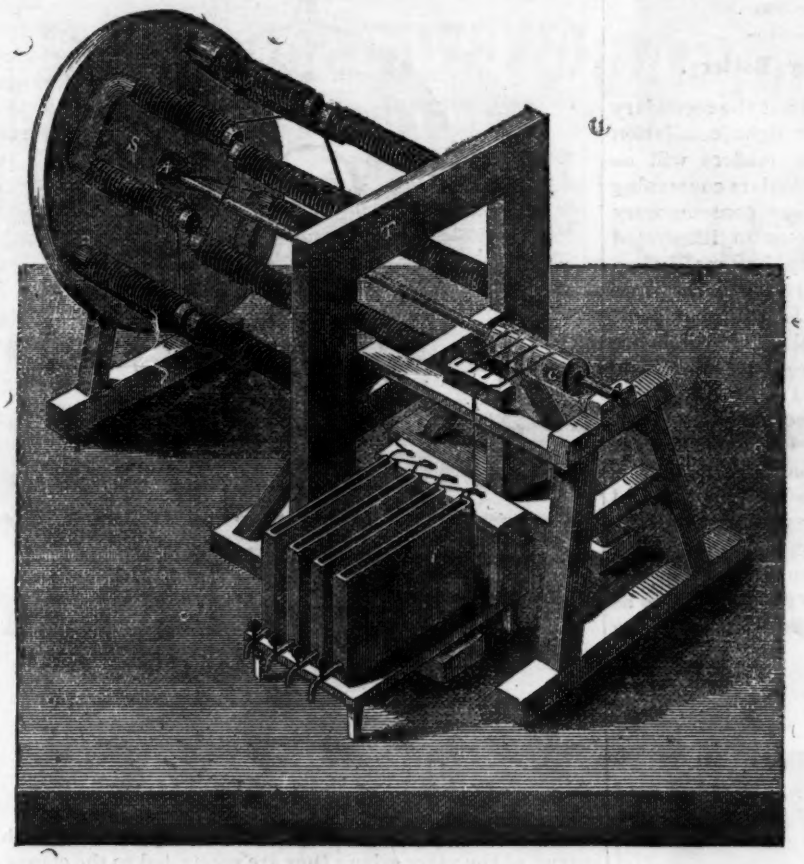


FIG. 1.

surprising that such sanguine expectations were entertained concerning the adaptability of the electric motor. But almost the first of the attempts to solve the problem of motive power from electricity met that great stumbling block, the *cost* of electrical energy when produced in batteries—and of necessity the high hopes entertained

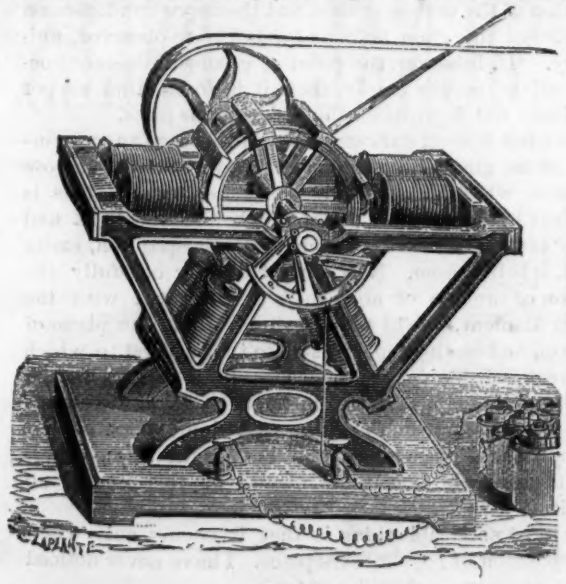


FIG. 2.

were dismissed. Almost immediately after this it occurred to scientists that it was more rational to reverse the problem, and to seek electricity from motive power instead of motive power from electricity. It is the pursuit of this problem that has brought the dynamo-electric machine o its present condition of excellence and efficiency. To-day the problem of cheap electricity stands solved by the dynamo-electric machine. It is now, therefore, that we can turn to the electric motor, and science receives it with open arms, like a banished exile returning after many years. After a sleep of twenty years—aye, twice twenty—it comes back, like Rip Van Winkle, to take its place in the domain of usefulness, and it even strides a step onward toward a new ideal, a new field—the transmission of power to long distances.

The electric motor is beginning even now to monopolize on the applications of the science. We are convinced that it will increase in popularity and meet with more favor every day. This is the reason which has induced us to say something of the past of the electric motor. There are many already interested in the subject who desire to know a little of its early history, to see if it offers suggestions of any value. We feel quite certain that a brief glance at the most noted early attempts to develop the electric motor will be interesting and of value to the readers of THE ELECTRICAL WORLD. The motion produced in the armature of an electro-magnet under the influence of a current seemed so suggestive, so applicable in the construction of motors that we need not wonder at the number of these attempts. It is to the few that occupied public attention and to which historical interest attaches that we shall, however, confine our attention for the present.

The first which we shall describe is that of Professor Jacobi, of St. Petersburg. Fig. 1 shows the earliest form which was given to this motor (1834). It was composed of two sets of electro-magnets. One set was fastened to a square frame *T*, with its poles projecting parallel with the axis and disposed in a circle, as shown in the figure; the other *S*, being similarly fastened to the round disc *A* attached to the shaft and revolving with it. There were four magnets in each set, and consequently eight magnetic poles. The current from a powerful battery was passed through commutator *C*, by which it was sent through all the coils of the electro-magnets. This tended to make them magnetic, and as they attracted each other the disc rotated. By means of a commutator carried on the shaft, the current was made to reverse eight times per revolution, just as the poles of the two sets of magnets arrived opposite each other. The result was that the attraction between the poles ceased and repulsion took place, which further assisted the motion. As the poles were alternately of different polarity the reversal also had the effect of causing attraction between each pole of one set and the next of the other.

Professor Jacobi subsequently modified this motor so as to increase its power. In the new form two sets of electro-magnets were fixed to stationary frames; one on each side of the rotating disc. Moreover, each set was composed of twelve electro-magnets. The electro-magnets on the rotating disc were made in the form of bars passing entirely through the disc. With this motor, which was

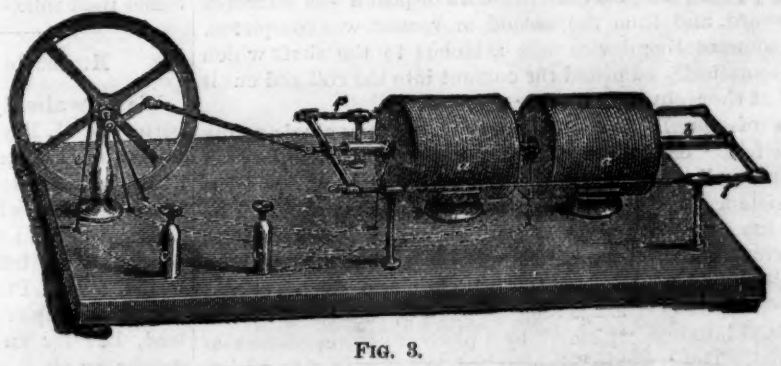


FIG. 3.

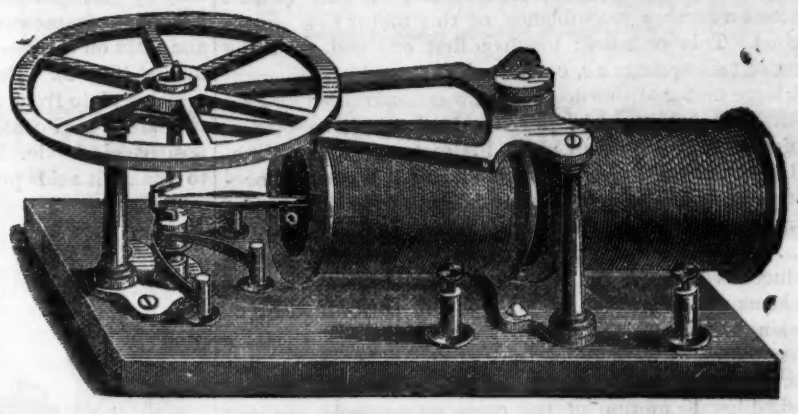


FIG. 4.

constructed on a large scale, experiments were made, with a view to the determination of its applicability to navigation. The motor was used to propel a boat on the river Neva. This boat was 28 feet long, 7 feet wide, and carried 14 persons. In the first experiments, made in 1838, the battery power was furnished by 320 Daniell cells. In later experiments, made in the following year, the battery power was furnished by 138 Grove cells, and the fumes

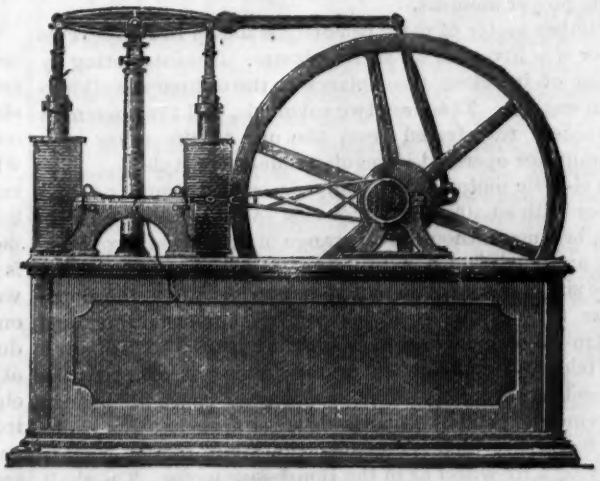


FIG. 5.

and gases are said to have been evolved so abundantly that a stack had to be provided for their escape. The highest speed attained was less than three miles. These experiments were made at the desire of Emperor Nicholas, and it cost him 60,000 francs ($12,000) to find out that this method

of employing electrical energy was not economical or practical.

A motor which has become well known in the laboratories, where it was once to be found very generally is the motor of Mr. Froment. This motor (Fig. 2.) recalls a breast wheel where, instead of water, magnetism acts upon the paddles. This construction will be readily understood from the figure with but little description. The wheels are made of brass or of non-magnetic material. The armature bars attached to their circumferences are of soft iron. There is a commutating device by means of which the current is cut off from each electro-magnet as soon as the armature arrives opposite its poles.

This commutator transfers the current to another electro-magnet until the armature has moved away sufficiently to bring the next armature within range, after which the current is again sent through the first electro-magnet. It appears, therefore, that in this motor the magnets are in action during only a part of the time. It follows that for a given power this motor would be heavier, other things being equal.

The most celebrated motor next to that of Jacobi was undoubtedly that of Professor Page, of the Smithsonian Institute. This motor depended upon a different principle from the others. When the end of a bar of iron is held near a hollow electro-magnetic coil or solenoid, the iron bar is attracted into the coil by a kind of sucking action until the bar has passed half way through the coil, after which no further motion takes place. Prof. Page constructed an electric engine on this principle about 1850. The solenoid was placed vertically, like the cylinder of an upright engine. A rod of iron, by way of armature, was fastened to a piston rod connected to the crank of a shaft carrying a fly-wheel. The core moved downward by its weight until its upper end was just leaving the solenoid, and thus one movement of the piston was accomplished. On passing the current the core or piston was attracted upward, and thus the second movement was completed. A commutating device was attached to the shaft which automatically admitted the current into the coil and cut it off at the right moment.

Professor Page soon improved on this single-acting electric "engine" by adding another solenoid, which could pull the piston in the other direction without the assistance of gravity. Fig. 3 shows this form of engine which takes *electricity* at both ends of the "cylinder," to borrow the expression of steam engineers. This arrangement will be readily understood. There are two solenoids and each has its iron rod passing through it, though they are joined into one "piston" by a piece of non-magnetic material. The "piston" is attached to a frame *f f*, which slides through supports, and in this way it is free to move inside the solenoids. The current is sent alternately through each coil by an eccentric disc on the axis (which suggests a further resemblance of this motor to a steam-engine). This eccentric touches first one and then the other of two springs *e e*, connected to the solenoids.

A large motor of this description was constructed by Professor Page, in 1850, which developed over ten horse-power. Professor Page sought to apply his motor to locomotives, and it is said that he actually constructed an electric locomotive to demonstrate the practicality of his scheme. But he never achieved much success, as might have been foreseen. Among the improvements which Professor Page introduced was that of making each solenoid double, so that the arms of a U magnet could slip into them instead of one single bar. As the solenoids attracted most strongly when the cores were almost out of them, he wound his solenoids in short sections, and a sliding commutator worked by the motion of the cores successively cut out the sections of coil which the cores had entered and transferred the current to others ahead of them, and thus the range of attraction was greatly increased.

Fig. 4 shows a motor exactly the same in principle and substantially alike in construction, which was produced in France by M. du Moncel in 1851. There is only one armature rod for both in this motor. It is short so as to pass out of the one solenoid almost entirely as it enters the other. The current is changed from one solenoid to the other by means of two eccentrics pressing against springs at the proper moment.

Another motor of early celebrity is shown in Fig. 5. This motor was invented by M. Bourbouze. It is interesting by reason of its close resemblance to the ordinary walking-beam engine. There are two solenoids, and the current is alternately transferred from the one to the other by a commutator operated in regular slide-valve style.

In electric motors it is usually desirable to combine efficiency with small size, and for this solenoids are not suitable, because, although their range of attraction is greater, they are much less powerful than electro-magnets of the same size. An electric motor somewhat after the Bourbouze type, often to be met with in laboratories, contains electro-magnets instead of solenoids. It may be compared to a telegraph sounder having an additional electro-magnet and armature instead of a spring to cause its return movement. The rocking-lever is connected with a walking beam, to which is attached the crank-rod of a shaft carrying a fly-wheel as in the Bourbouze motor. The shaft also carries eccentrics, as in the Page motor, which send the current alternately to each electro-magnet.

These motors and the several modifications which are contemporaneous with them do not possess very much practical value in the light of the present state of the science. The power is not applied to advantage in any of them, as may be readily seen. Magnetic attraction decreases as the square of the distance, and consequently when the armature is furthest from its magnet or solenoid the action upon it is weak, whereas it is precisely there, when inertia is to be overcome, that it ought to be strongest. Once the motion is established, then the attraction does not need to be as strong, while in these motors the nearer the magnet or solenoid and the armature come to each other the stronger the attraction.

A great disadvantage common to all these motors is that they have "dead centers;" that is to say, if the wheel happens to stop at the end of a half turn with its crank exactly in a straight line with the crankshaft, then it matters not which way the attraction takes place, the crank will not be moved. The wheel must be turned a little until the crank has passed by the dead center before the action on the armature can cause it to move, and if the momentum of the fly-wheel were not sufficient each time to make the crank pass the dead center the motors would stop at every half turn.

The electric motor of the present day is comparatively free from these disadvantages for, strangely enough, even while it was lying forgotten it was unconsciously approaching perfection under the guise of the dynamo-electric machine, as it was realized at last that dynamo-electric machines are reversible and can produce motive power by the application of electrical energy just as well as they can produce electrical energy by the application of motive power, and that good dynamo-electric machines are also good electric motors. This revelation was a key which permitted science to unlock the treasures in one department and distribute them in a collateral department, and thus two problems—that of the cheap generation of electricity and that of its application as a motive power—found their solution at one and the same time.

M. Emile Reynier's Secondary Battery.

We have already given some details about the secondary battery of M. Reynier used in an electric light installation at Nantua, France, with success. Our readers will no doubt be interested in the following particulars concerning this invention, which we glean from our contemporary *L'Electricien*, to which M. Reynier has sent an illustrated account of the battery. This secondary battery differs from that of M. Planté in construction and adaptation rather than in principle. The active material is still peroxide of lead, but for an electro-positive metal M. Reyneir uses copper or zinc. The construction presents interesting modifications. The positive plate (Fig. 1) is of lead in the form of a cylinder, the surface being increased considerably by corrugations and perforations. It is supported on a wooden framework placed in a wicker basket (Fig. 2) and rests on a cross-piece (Fig. 1) on the bottom of a deal bucket (Fig. 3). The wicker basket serves to separate the positive plate from a cylinder placed outside of it, which is made of lead coated with copper or zinc, and forms the positive electrode. The bucket (Fig. 3) is tarred inside so as to make it acid proof. The solution is dilute sulphuric

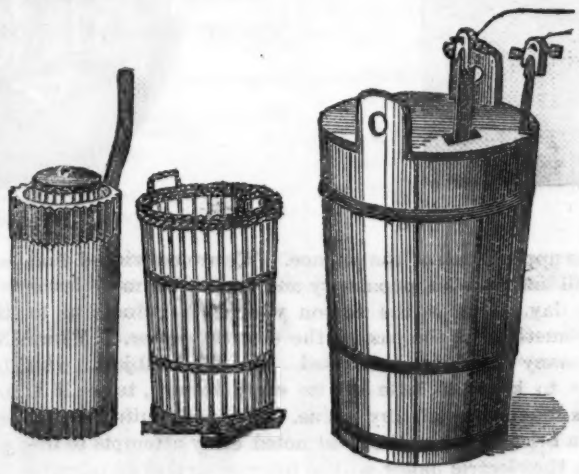


FIG. 1. FIG. 2. FIG. 3.

acid, containing in some cases sulphate of zinc, in other cases sulphate of copper. On passing the current, the negative electrode of lead is peroxidized, while the zinc is deposited on the positive electrode, or else copper is deposited when the solution used is sulphate of copper. The electromotive force is 1.68 volts with a cell using copper, and 2.3 volts with a cell using zinc. The latter is therefore more powerful than the former; this is because zinc is more electro-positive than copper. The zinc cell would seem to be preferable, but a local action arises on the surface of the zinc itself which tends to reduce its efficiency to a certain extent. At the installation at Nantua there are thirty-six of these secondary batteries; eighteen using zinc and eighteen copper. The total electromotive force is 71 volts. The resistance is .9 ohm. Each accumulator weighs 22 kilograms (about 45 pounds), and is capable of storing 300,000 coulombs (5,000 ampère hours). These cells were constructed with some haste, but they have given excellent service. It is the intention of M. Reynier to modify the construction so as to make them less clumsy and more compact.

Molecular Radiation in Incandescent Lamps.

About 1879 Professor Crookes, in England, discovered that when the discharge of an induction coil takes place in Geissler tubes from which the air is exhausted to a very high vacuum the molecules of the gases remaining in the tubes exhibited certain peculiarities of behavior, whence he was led to advance the hypothesis of a fourth state of matter—the utra-gaseous or radiant state. It appears in effect that when a very attenuated atmosphere is subjected to electrical discharges, the molecules of the air or of the gases composing it are impelled in *straight* lines, radiating from the positive pole and moving in all directions. Various theories have been invoked to account for the phenomenon, and, as we showed in our editorial of January 13th, 1883, in "Progress in Electrical Science in 1882," there is a good deal of question whether the "fourth state" theory is to be accepted as the true one or not. There is undoubtedly much to be discovered in this field of research, and these discoveries will be of the utmost value to the science, as adding to our knowledge of causes.

In connection with this subject we present to our readers a phenomenon of the highest interest, not only when considered as an effect, but from the theoretical point of view, discovered by Dr. J. A. Fleming. We reproduce from *The Electrician*, London, the following note of Dr. Fleming and the accompanying illustration:

Not long ago a curious phenomenon came under my notice in connection with the burning of Edison incandescent lamps, which presents sufficient interest to warrant me drawing the attention of physicists to it.

As is well known, the carbon filament in the Edison lamp is of a horseshoe form. The two extremities of the loop are clamped into small copper clamps on the ends of the platinum wires, which are sealed through the glass.

EDISON LAMP USED BY DR. FLEMING.

The ends of the carbon loop are electrotyped over with copper at the place where they are connected to the clamp, in order to make a good contact. If this precaution is omitted a loose contact may be formed, the result of which will be a generation of heat at that point. In the ordinary working the life history of a carbon filament is something as follows: At some point or other the filament is probably thinner than at other places. At this place there will be a greater generation of heat and a higher temperature. Volatilization of the carbon ensues, and the vapor condenses on the sides of the glass bulb, as far as I have observed, uniformly. If, however, the point of greatest resistance occurs on the copper clamp, then it is found that copper volatilizes and deposits on the inside of the glass.

But what is most curious is that in this case an examination of the glass envelope shows that there is a narrow line along which no copper has been deposited. This is seen best by holding the lamp up before the light and slowly turning it round. In one particular position, easily found, it is best seen. Now, on examining carefully the position of the line of no deposit as compared with the carbon filament, it will be seen that it lies in the plane of the loop, and on the opposite side to that nearest to which the break of the loop has occurred. It is, in fact, *a shadow of the loop*, as shown in the illustration herewith.

The conclusion which must be arrived at, then, is that the copper molecules are shot off in straight lines, otherwise it impossible that there should be this line of no deposit.

The most noticeable thing is that it occurs only when the deposition of copper takes place. I have never noticed it in an ordinary carbon deposit.

Hence, there must be some essential difference between the vaporization of the carbon and that of the copper. The carbon deposit resembles more the condensation of a

vapor and is uniformly distributed, but the copper deposit exhibits the character of a molecular radiation or shower taking place from a certain point.

The whole phenomenon calls at once to mind the beautiful researches of Mr. Crookes with vacuum tubes. Here, however, we are dealing, not with an induction coil discharge, but with a comparatively low potential. I have never failed to see the effect in any lamp which has had a deposition of copper on its interior.

It is interesting to note how nearly the color of transparent copper resembles that of transparent gold. The similarity of the surface color of pure unoxidized copper and of gold is accompanied by a near resemblance in color of the two metals in their films.

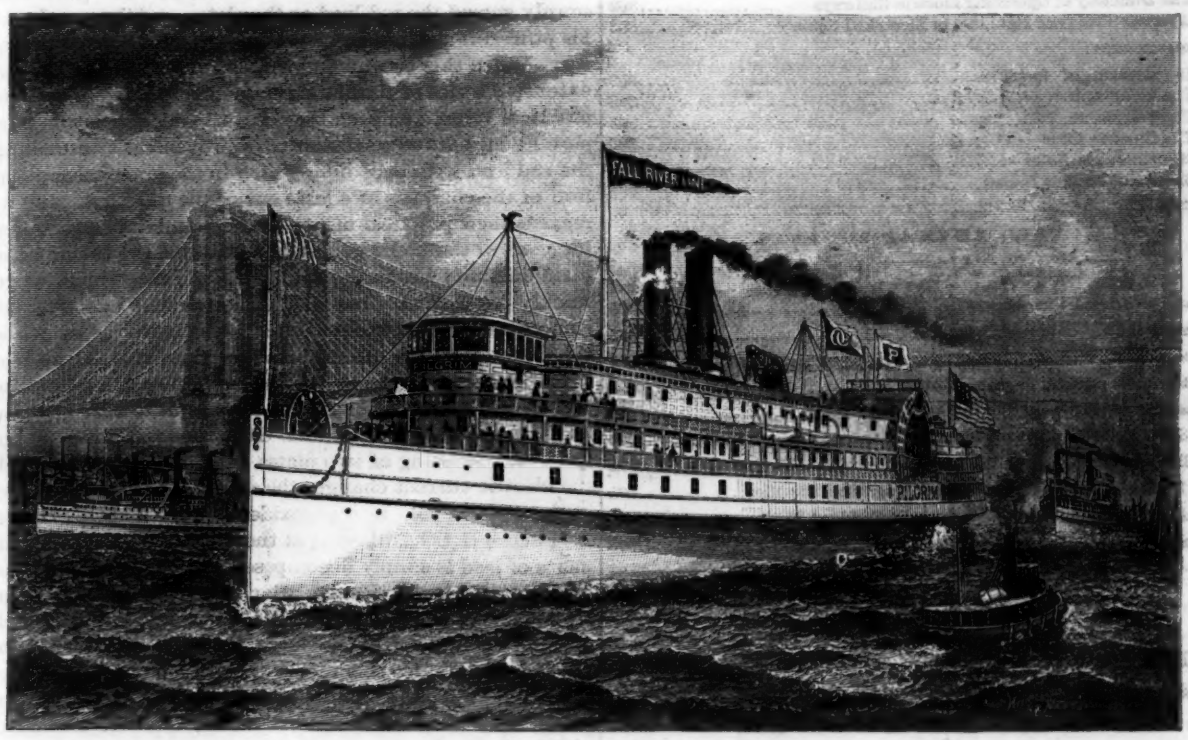
The Electric Light Installation on Board the Pilgrim.

The electric lighting of the Pilgrim, the new steamer of the Fall River line, has recently been briefly described in THE ELECTRICAL WORLD. On Saturday evening last Capt. Benjamin M. Simmons held a reception on board the splendid new craft, designed to show the beauty and brilliancy of the electric light, as well as the safety and splendor of the steamer. By invitation of Mr. J. H. Vail, superintendent of the Edison Company for Isolated Lighting, this journal was represented.

The accompanying illustration and brief description of the new floating palace may be of interest to our readers. The Pilgrim was built by John Roach & Son, Chester, Pa., and only arrived from Fall River on Saturday afternoon. She is considered the finest craft of her class afloat. Her greatest length is 390 feet, her extreme width 87 feet 6 inches, and her hold is 18½ feet deep. Her registered tonnage is 3,500 tons. The hull is built of iron, on the longitudinal bracket system; that is to say, the Pilgrim is a ship within a ship, and has 103 water-tight compartments. She is expected to make twenty miles an hour. The paddle wheels are 41 feet in diameter, and the walking beams weigh 33 tons. Each one of the 250 staterooms contains black walnut furniture, electric light and call-bell, and a plate-glass mirror. Beautiful frescoes adorn the grand saloon, which is richly carpeted. She is said to be able to carry a thousand passengers comfortably.

The Pilgrim, as already stated in these columns, is lighted solely by electricity. The current for the lights is furnished by three dynamo-electric machines, two of the "K" type and one of the "L" or next smaller size. These machines each have the same electro-motive force, and are connected with the leading conductors in parallel circuit. Their standard of electromotive force is 110 volts, but they are allowed to develop only 108 volts, in order to adapt the current to the resistance of the lamps. These machines are driven by two Armington & Sims high-speed engines, one 8½x10, or type "B," the other 9½x12, or type "C." A special boiler of 150 horse-power furnishes the steam at 80 pounds pressure; and in case of necessity connections may be made with the donkey boilers or the main boilers, as explained in our last issue. These engines are both belted directly to the dynamos, the former serving to actuate one of the K dynamos and the latter operating the other K and the L dynamo. The field of each dynamo is wound in derivation, as in all the Edison machines, in order that the amount of current supplied the lighting circuit may regulate itself to the number of lights in use at any given time. But as this method is not of itself sufficient to make the regulation absolutely perfect, the lighting company has resorted to the device of Mr. Edison, which causes the resistance of the derived circuit to diminish so as to make a stronger magnetic field when more lights are used and the current requires to be stronger, or to increase and weaken it when the number of lights used is less. The governor, by means of which this is accomplished automatically, is one of the most ingenious features of the installation. The box which holds the resistance coils, which are switched into the field circuit as occasion requires, supports a glass case, which contains the governing apparatus. A large "relay" magnet in this case is included in a derivation of the external circuit, and is balanced by a spring. The armature carries two contact points, one on each side. Two large U electro-magnets are near this relay, their armatures attached to a frame rocking shaft placed midway between them. This shaft carries an arm which is prolonged downward, like a pendulum, and corresponding to the ball of the pendulum is a flat strip of sheet copper bent to form a rubbing contact which can pass over contact strips separated by insulation. These strips look like a portion of the Gramme commutator inverted; that is to say, a commutator in which the brush rubs on the inside of the circumference, exactly as in the new Siemens dynamo described in THE ELECTRICAL WORLD of May 19. The resistance coils loop from one to the next of these strips, precisely as the sections of a Gramme armature. The field magnet circuit goes to one end of this "commutator," passes through the contact piece of the pendulum and from this back again to the machine. Accordingly, when the rubbing contact touches the first strip none of the resistance coils are included in the field circuit, while if it touches the last strip all the resistance is introduced in the field circuit. When the current in the external circuit is normal the armature of the relay is held balanced against its retractile spring in such a manner that neither of its contacts touch the connections on either side. If the current weakens the spring pulls the armature back and a contact is formed which transmits the current to one of the magnets of the regulator, and causes the frame to rock and the rubbing contact to move so that some sections of the resistance in the field circuit are cut out. As soon as enough resistance is cut out and the current in the external circuit increased to its normal value, the relay cuts out this magnet and the rubbing contact remains in this position. If the current becomes too strong, the armature is attracted sufficiently to close the circuit through the other magnet. This causes the rubbing contact to move backward and resistance is introduced into the field circuit. An incandescent lamp is included in the circuit of each of the two electro-magnets, and its light serves as an indicator of the condition of the circuit, since one glows while the current is below and the other while above the standard value.

To the electrical engineer the most interesting part of the whole plant is, without doubt, the manner in which the conductors are disposed throughout the vessel and the method of arranging and connecting the lamps with respect to them. The steamer is divided into four sections with reference to the distributing current. It may be said that the distribution proceeds from the centre of the vessel, or rather the centre of illumination. The plant is located in the fore part of the hold, but the current is conveyed by main conductors on each side, inclosed in iron tubes, like the conductors in Edison's street system, to about the centre of the vessel, where they go upward, passing through every deck. On each deck is a safety box, like those at street corners in the street system, and a conductor goes from this to the front of the steamer, supplying the lights on its way, and a similar conductor goes to the rear. The arrangement is the same for each deck, which has four sections—two on each side—and the safety box provides that one section may be cut out without interfering with the others.



THE NEW STEAMER "PILGRIM."

In the engine room four switches are placed within easy reach of the engineer, which gives him control of all the lights on that deck. It is estimated that the total length of conductors and wires used throughout the boat is not less than ten miles.

The lamps are of 16 and 10 candle-power, and have an average resistance of 137 and 250 ohms, respectively. All are connected in multiple or parallel circuit, and it is, therefore, because the 16-candle lamps have a lower resistance and receive proportionally more current than the others, that they give more light. The lamps are disposed as follows:

	16 candle-power lamps.	10 candle-power lamps.
Grand saloon and gallery	199	250
Main deck	131	138
Dining room and after cabin	32	110
Forward cabin	15	37
	377	535

16 candle-power A lamps	377
10 candle-power A lamps	535
Total number of lamps	912

Each lamp is provided with a safety cut-out, in case of accident, except those in the chandeliers, which have a cut-out only for each group.

The installation is probably the largest and most complete which has yet been made on board of any steamship, and the scrupulous attention to details which it reveals reflects the highest credit on the Edison Company for Isolated Lighting, that had the contract for the work. The installation is highly successful when judged merely by its effects. The numerous guests at the reception were enthusiastic in their appreciation and admiration.

We need not here dwell on the advantages of electric lighting over all other methods of illumination on board vessels. In a properly arranged system the danger of fire is reduced to almost complete insignificance, and this fact is recognized by the steamboat and insurance companies. Besides, it is not wanting in other advantages. The absence of heat, the non-contamination of the air, and the convenience of having the lights ready when wanted are of themselves convincing arguments in its favor.

Mid-Ocean Telegraph Stations.

The ocean, upon which man has been unable to leave a track, is at last likely to succumb to the marvelous power of the human mind and bear upon its tempestuous bosom evidences of man's genius which shall defy storm and wave. Mr. W. C. Anderson's bold plan for founding "deep sea light-houses," is discussed in *Chambers' Journal* for June as a plausible scheme worthy of consideration and not extraordinarily difficult of accomplishment. It says:

Owing to our insular position we are dependent for our storm warnings on our transatlantic neighbors; but if it becomes possible to found a floating telegraph station, say one thousand miles from our shores, in mid-Atlantic, we could have warnings of coming storms quite twenty-four hours before their arrival.

Mr. Anderson's plan, as recently explained to the London Society of Engineers, is to construct a hollow cylinder of riveted iron work, 290 feet long, to consist of two sections—the upper part to be 140 feet long, destined to rear its head above the waves and fitted as an ordinary light-house, while the remaining portion of the tube is to be ballasted so as to sink below the water line and counteract the force of winds and waves on the exposed part. The whole apparatus is to be anchored in deep water by heavy steel cables. The inventor claims that it would be easy to tow such a structure to the spot selected for it, and then by admitting water to the lower section it would assume an upright position and ride the waves like a bottle.

On this subject the *Herald*, of this city, thus expresses itself:

"The idea of founding mid-ocean floating telegraph stations has long been discussed, but no engineer, unless it be Mr. Anderson, has yet devised any structure which would remain stationary, and if connected with the telegraphic cables, would not in stormy weather endanger them. The depth of water to which the agitation of a wave reaches never bears a large proportion to the wave's dimensions, the motion diminishing in geometrical progression as the depth below the surface increases in arithmetical. 'In the case of a wave a quarter of a mile in breadth and forty feet in height,' as Sir John Herschel shows, 'the displacement of the water at a depth of 1,320 feet, in its passage over it, would be less than an inch, and would be incapable of disturbing the smallest grain of sand.' As Atlantic waves seldom attain these dimensions, it seems highly probable that the construction of a deep-sea floating station which can in all weather be kept in place is not a mechanical impossibility. The success with which gas-lighted buoys have been maintained on storm-swept shoals on our sea coast may be taken as evidence that such a structure as Mr. Anderson devises might be made, with some modifications as to shape and length, to stand moored to anchor blocks in deep water. If this much could be demonstrated the work in connecting the structure with one of the transatlantic cables would be simple; and the structure, thus serving the purpose of a mid-ocean telegraph station, would be an immense boon, both to navigation and to meteorological science.'

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CONTENTS.

ILLUSTRATED ARTICLES: PAGE.
Historical Electric Motors....387
M. Emile Reynier's Secondary Battery....388
Molecular Radiation in Incandescent Lamps....388
Electric Light Installation on Board the Pilgrim....389

EDITORIAL:
"Mho."....390
The Theory of the Secondary Battery....390
Scrivanoff's New Battery....390
Mr. R. G. Brown's Electric Governor for the Engines of Ocean Vessels....390
Old Dymanos Better than New Ones....391
The Value of the Ohm....391
A New Time System....391
Fire-Proof Insulation....391

MISCELLANEOUS:
Mid-Ocean Telegraph Stations....389
Electric Light Companies in Litigation....391
Status of the Mexican Telephone Company....391
Telephony in Philadelphia....392
The Edison Electric Light Company's Work....392
Misdirected Inventive Genius....392
Telephone Progress in Ohio and Kentucky....392
The Difficulty in Operating Electric Railways....392
Average Practical Dabblers in Electrical Science....392

DEPARTMENTS:
Department of Inquiries....393
The Telegraph....393
The Telephone....393
The Electric Light....393
Miscellaneous Notes....394
Electrical Patents Issued....394

NEW ADVERTISEMENTS.

PAGE.
Maurice Brick.—Fine Cigars....395
Hearne & Co.—Cat-head Cards....395
Electrician.—Position Wanted....395
Baldwin, Hopkins & Peyton.—Notice....395
Daniel F. Beatty.—Beethoven Organs....395
E. & F. N. Spon.—Electro-Magnets; Elements of Construction....395
J. B. Lippincott & Co.—Worcester's Unabridged Dictionary....396
C. E. Jones & Bro.—Telegraph and Electrical Supplies....401
G. & C. Merriam & Co.—Webster's Unabridged Dictionary....401
Whiting & Co.—Imported Cards....402

"MHO."

This is the latest "addition" to the catalogue of electrical units, and no less eminent a personage than Sir William Thomson is its sponsor. Very few persons would ever guess at first sight what this unit could be, or why Sir William went to so much trouble to procure such a homely, unwieldy little word. We are quite sure most of us think that units are already numerous enough, since the Electrical Congress has given us an invoice of ampères and coulombs, to add to farads, ergs, watts, and what not. It is difficult to realize that there is any room left in the vocabulary of the science even for such a small word. However, there is a place for a new term, and this fits it admirably. Resistance in electricity means obstruction to the passage of current. Its unit is the ohm. Now, what is conductivity? The *want* of obstruction. It is an *opposite* condition; in other words, it is the *reciprocal* of resistance. And now, if we stop to think of it, we will find that we have no unit of electrical conductivity. Sir William Thomson proposes to establish one. To show the reversal of relation between it and the unit of resistance he reversed Ohm's name, by uttering it into a phonograph and "grinding" it out backward, with the above result.

It is fortunate that it was Dr. Ohm who gave us that important law, as it is not every name that would reconcile itself so easily to such a "reversal of polarity." Let us imagine Lenz or Coulomb thus reversed, and we would begin to feel discouraged even before we had occasion to use the term.

Sir William Thomson suggests that the subdivision "milli-mho" would be very convenient for incandescent lamps. There are also other cases where it would be more convenient to express the conductivity rather than the resistance, and no doubt the word will prove very useful.

The Theory of the Secondary Battery.

It appears from the German papers that the secondary battery has been receiving attention for several years from Dr. Aron, of Berlin, who lately gave his observations on this subject before the Physical Society. It is claimed that Dr. Aron has been following up the secondary battery, ever since the publication of M. Planté's essays, published about two years before the discovery of Faure. According to his statement before the Physical Society, Dr. Aron sought to determine a convertible electric element which, being theoretically possible, might also be available for practical purposes. He first of all tried to make the Daniell cell convertible by using, instead of the two amalgamating fluids, hydrate of soda and sulphate of copper, which do not amalgamate, but without success. Like many others he repeatedly tested Planté's already published statements regarding convertible cells of plates of lead immersed in dilute sulphuric acid, and which had to be charged in a very definitely prescribed way, but without any certain results. The cell sometimes became charged and discharged alternately, at other times not. He accordingly tried plates of lead which had been previously crystallized by corrosion, and these he found far more reliable. He therefore constructed accumulators of plates of lead in sulphuric acid to which some nitric acid had been added. Although more certain in their application, these were by no means equal to the practical requirements. The favorable results of the corrosion, as regarded the crystalline surface, a point also confirmed by Planté himself, was explained by Dr. Aron, who attributed it to the disintegration of the metal. He therefore tried to increase the effect by using lead-sponge, but without result. At that time he also thought of red lead, but made no experiments with it, because he knew of no means of fixing this powder to the lead plate conductor. It is now known that M. Faure simply spread the red lead on the plates, and thus produced his powerful accumulators possessing great storage capacity. When this became known, Dr. Aron carried out an extensive series of similar experiments in order to test its practical value, and even increase it. For the latter purpose he introduced a substantial improvement by attaching the red lead with collodion, which in the practical application of the chains is of course out of the question. But as regards their practical utility the accumulators have fallen far short of the hopes generally entertained of them. The main difficulty lies in the thin plates of lead, which, when thickly covered with red lead, although very effective, become corroded and useless after being once used, while thick plates, by the formation of sulphate of lead, are rendered ineffective. As to the theory of accumulators, to rightly understand it, it is very important to bear in mind the fact established by Messrs. Gladstone and Tribe, that in the cell, consisting of two plates in dilute sulphuric acid, the electric current changes the sulphate of lead generated at the positive pole into peroxide of lead, $PbSO_4+H_2O+O=PbO_2+H_2SO_4$, whereas at the negative pole the sulphate of lead is simply decomposed into sulphuric acid and disintegrated lead. Hence, after charging, the cell consists of $Pb \mid H_2SO_4 \mid PbO_2 \mid Pb$, a combination which yields a very powerful discharge, available also for a protracted period. To this theory it has been objected that at the negative pole the sulphate of lead cannot be decomposed into lead and sulphuric acid; but Dr. Aron has satisfied himself that, under the influence of the hydrogen beginning to be generated, very thin layers of sulphate of lead become so reduced, thicker layers alone resisting decomposition. The process at the positive electrode being really such as is described by Gladstone and Tribe, the above theory of accumulators may, broadly speaking, be accepted as correct. As regards the peroxide of lead, the speaker pointed out that this combination is admittedly of a brown color, whereas the substance deposited on the positive plate is black. From a more searching examination of the substance it resulted that it is not the peroxide but a hydrate of the peroxide of lead; and Dr. Aron suspects that there is here less question of a hydrate PbO_2H_2O than of a combination of the oxide of lead with a peroxide of hydrogen. A series of theoretically interesting isolated phenomena may possibly be produced by following up the processes here in question; but in the present conditions Dr. Aron holds the practical application of the accumulators to be hopeless.

Scrivanoff's New Battery.

This battery has attracted considerable attention in Europe, and will be interesting and perhaps suggestive to American electricians. It is essentially a modification of the so-called "chloride of silver battery." A prism of carbon is covered all over with pure chloride of silver and immersed in a solution of potassium hydrate (*KHO*), or sodium hydrate (*Na HO*), popularly known as caustic potash and caustic soda, in water, the quantity of the salt dissolved being between 30 and 40 per cent. of the weight of the liquid. A plate of zinc is placed near this carbon and forms the positive electrode. Under the influence of the solution itself, especially when it is concentrated, the chloride of silver becomes partially reduced to the brown oxide (*Aga O*), and, as a part of this oxide appropriates the chlorine of the unreduced chloride, the result is that the carbon becomes covered with a mixture of chloride (*Ag Cl*), sub-chloride (*Aga Cl*) and oxide; but this is not a disadvantage, since all three salts are nearly equal in their effects. When the circuit is closed, the silver chlorides and oxides are reduced to a spongy metallic state, adhering to the surface of the carbon, while the zinc dissolves as a chloride or as an oxide in the caustic solution. To prevent the falling off of the spongy silver from the carbon it is enveloped in parchment, felt, or paper. The cells are of ebonite, either square or round. The active surfaces are larger than in the "chloride of silver" battery, and the internal resistance is thereby very materially reduced. M. Scrivanoff pretends that the electromotive force of his battery is from 1.5 to 1.8 volt, or nearly as high as that of the Bunsen battery. There is little or no polarization in this battery, and it will continue to give a current until the zinc is all dissolved, or until the chloride of silver is all reduced to the metallic state. In the latter case, all that is necessary to restore the battery is to plunge the silvered carbon with its porous covering of parchment paper into a chloridizing bath, after it has been well washed in water, to remove the solution. This chloridizing solution is composed of one hundred parts nitric acid, five or six parts hydrochloric acid, and about thirty parts water, by weight, though different proportions may also be used. The effect of this solution is to reduce the spongy metallic silver on the surface of the carbon to the condition of chloride as before, and thus the covered carbon becomes as efficient a negative electrode as originally. It may be said, also, that instead of resorting to this method, the exhausted cell could be recharged by sending the current from a dynamo-electric machine through it, in the opposite direction, just as if it were a storage cell. The charging current causes the zinc which was dissolved to become deposited on the zinc electrode, and the chloride set free at the silvered carbon combines directly with the silver to form silver chloride. If the zinc is amalgamated the local action should be very slight in this battery, consequently its efficiency as an accumulator ought to be great. Whether it would be as small in bulk for the same power, however, is somewhat doubtful. Still, we believe there is something worthy of consideration in this battery, from the point of view of those interested in the subject of the storage of electrical energy. So far the attention of all is directed to the use of oxygen as the active element, and chlorine, which is still more highly electro negative than oxygen, is not thought of. There is a good field here for research, and we would be glad to see somebody explore it.

Mr. R. G. Brown's Electric Governor for the Engines of Ocean Vessels.

Perhaps very few electricians realize that the question of regulating the speed of propelling engines on ocean steamers is worthy of their attention. Nevertheless it is one of the problems which have ever been the torment of the naval engineer, and one which, from its very nature, could only be solved by the agency of electricity. In mid-ocean the propeller of the vessel is often in imminent danger of injury, because at times the stern of the vessel is thrown entirely out of the water and the propeller encounters no resistance except that of the air. In this condition its speed increases suddenly at an enormous rate; and when it becomes submerged again the sudden strain on its shaft and blades is very great.

Attempts have repeatedly been made to improve the methods of regulating the speed of propelling engines, but in every case the remedy was always too slow; that is to say, it did not prove effectual at the instant it was required, and the few seconds which elapsed between the changes of speed and the action of the regulator were all-sufficient to allow the damage to occur. It is in this case exactly as in the case of the dynamo-electric machine intended to supply a constant current even while the number of lights is being changed—the regulation should be instantaneous.

Mr. R. G. Brown has proposed an electric device for the purpose which is ingenious and yet quite simple, and which may at least prove suggestive. In this invention, an electro-magnet attracts an armature in opposition to a spring, as long as the propeller remains submerged, because its circuit is completed through the water, one wire being directly connected with the copper sheathing of the vessel, while the other is insulated and ends near the shaft of the propeller where it is bared. As long as the shaft of the propeller is under water the circuit remains complete; but as soon as the vessel plunges forward and the shaft is lifted out of the water the circuit is interrupted. The armature of the electro-magnet instantly springs back, and by its motion causes a small steam engine to start a mechanism that closes the valve admitting steam to the cylinders of the propelling engines. When the propeller is submerged again the mechanism is disconnected from the engine and the valve gradually reopened. Only half of the propeller is still encountering the resistance of the water when the shaft comes out, and, therefore, the valve begins to close before the propeller can attain a very great velocity of rotation. Likewise when the propeller becomes submerged again, the motion remains slow until the shaft comes under water and thus the strain which would result from a too sudden increase in speed is obviated. It is plain that a number of contact points might be provided instead of a single one, and by placing each

above the other, the rate at which the valve is closed or opened could be altered according to the amount of displacement of the vessel.

Old Dynamos Better Than New Ones.

It is well known to electricians that dynamo-electric machines improve in efficiency with age. The fact has not been generally explained, however.

This improvement appears to result from an increase in magnetic capacity of the iron used in both the armature and magnetic field. This increase of magnetic capacity is in turn due to interesting molecular changes produced in the iron by long-continued and often-repeated magnetization. In their natural condition the molecules of all matter offer a certain amount of resistance to any power tending to produce motion in them.

What is called the "coercive force" of magnetic bodies is simply the resistance which their molecules offer to the power that tends to rotate them, or urges them to assume a peculiar relative position giving rise to the condition of "magnetization." This resistance is doubtless purely of a mechanical nature, for when the molecules are naturally free of motion among themselves, or in other words, when the metal is soft, the condition of magnetization is brought about more readily, and to a higher degree of intensity. There is another good proof that this resistance must be mechanical. Just as by bending a piece of iron repeatedly the cohesion between the molecules becomes diminished, so by frequently magnetizing a piece of iron, it becomes softer and its coercive force considerably reduced.

In dynamo-electric machines that show an increase in efficiency it is found, strangely enough, that the iron of the armature and field magnets, more especially of the pole pieces of the magnetic field, has become much softer, the degree of softness bearing an evident relation to the degree of enhancement in efficiency. In this case the magnetism itself undoubtedly served to bring about this change, just as a mechanical force vibration, for instance, would have done. It literally jarred the molecules apart so that they could move more freely to respond to the polarizing influence. That such a vibration or trepidation of the molecules occurs in the molecules of the pole pieces, at least, cannot be doubted. Each molecule is constantly held *rigidly* in the line or axis of polarity of the line of force traversing it, and as the reactions—more especially those taking place under Lenz's law—are constantly causing oscillations in the lines of force, as they are cut by the coils of the armature, each molecule sways to and fro bodily, and the effect of such vibrations must be to soften the iron and reduce its coercive force.

The Value of the Ohm.

The ohm, as is well known, is an arbitrary measure, since it is referable to a standard coil kept by the British Association, just as is the meter to a standard kept at Paris. Of late years, as the absolute system grows into favor among scientists, it has become desirable to know exactly the value of the B. A. ohm in absolute measure (C. G. S.). It would no doubt be much better if the ohm were exactly equivalent to some definite absolute value, but as it is too late to make the change, and we must be content with knowing its exact value in order that we may reduce it to absolute units at our convenience.

The British Association unit has been found by Lord Rayleigh and by Sidgwick to be .9868 of the true ohm (10^9 centimeters per second), which differs by only 0.2 per cent. from .9870, the number derived from Joule's electro-thermal measurements described in the British Association Committee's report of 1867, with 772 Manchester foot-pounds taken as the dynamical equivalent of the thermal unit from the measurement described in his Royal Society paper of 1849, and confirmed by his fresh measurement of 20 years later, published in his last Royal Society paper on the subject. It is satisfactory that, whether for interpreting old results, or for making resistance-coils anew, electricians may now safely use the British Association unit as .9868, or the Siemens unit as .9413, of the ohm defined as 10^9 centimeters per second.

A New Time System.

A new system of synchronized time-keeping has lately been introduced in New Haven, Conn., by the Standard Time Company, of that city. It is said to have worked successfully in London for many years. The clocks used are good time-pieces with the motive power furnished by springs or weights. They run independently of the electric current. The office of the current is to give once an hour, or less frequently if desired, a signal which sets every clock at the same time. The signals are always sent out at the even hours, and the clocks are set by bringing the minute hands to the XII point. The system has the advantage of having the most accurate observatory time. The signals are given from an astronomical clock at the Yale observatory, the monthly variation of which is but a fraction of a second. The clock, with synchronizers attached, is bought and becomes the property of the purchaser, who has nothing further to do in the matter. The clock is hung on the wall, and for a yearly rental it is wound and kept right. Whoever has one of these clocks will receive signals twenty-four times a day, 365 days in the year. The signals are sent over covered wires, thus removing all danger of crossing which will occur with the best system of uncovered wires.

Fire Proof Insulation.

In electric light circuits where eventuality of a short circuit cannot always be foreseen, the question of insulation is undoubtedly one of great importance. If a conductor can only carry a current of twenty auspices without heating unduly, it will evidently be unsafe to carry a current of twice or thrice that volume. The conductor itself may not be destroyed, but the heat which it gives off may prove an element of danger. Accidents have actually happened in this very manner. We hear that a patent has been granted in England on a new insulating compound said to be fire proof. It consists simply of two substances, linseed oil and tungstate of soda boiled down together to the consistency of a thick varnish. This varnish is applied to the naked wire itself, or else it may be used to paint its covering. The fire proof qualities of the compound depend on the refractoriness of the tungstate of soda to heat.

Electric Light Companies in Litigation.

The Consolidated Electric Light Company brought suit on the 9th inst. in the United States Circuit Court, this city, against the Edison Electric Light Company, the Edison Company for Isolated Lighting, the Edison Illuminating Company, and also Marx Mayer and Delin Jacobs, patrons of the Edison companies, for infringing the patents of the Consolidated Company. All other electric light companies will be sued as soon as the necessary preparations can be made. The secretary of the Consolidated Company says the company did not single Mr. Edison out, but the complaint against his companies happened to be prepared first, and consequently was first filed.

In the complaint the plaintiffs allege that William E. Sawyer and Albon Man, of Brooklyn, were the first and original inventors of a certain "electric light system," and the adjuncts to be used therewith; and also certain additional inventions, specified as follows: Improvements in regulating the electric light; improvements in electric lamps; improvements for the treatment of carbon for electric lighting and also improved carbon for electric lighting. These inventions, it is claimed, are the basis of all electric lighting systems, and every other company than the Consolidated is guilty of infringing its patents. The inventors secured their patents June 25, 1878, as the records of the government show, and subsequently they transferred them to the Electric Dynamic Light Company of this city. The plaintiffs, it is alleged, paid large sums of money in purchasing and perfecting the inventions, and they allege that the defendants received notice of the plaintiffs' rights to the patents, but notwithstanding this notice they conspired together and with others to make and sell the inventions.

Mr. Amos Broadax, attorney for the plaintiffs, after stating the foregoing facts, said:

"The Consolidated Company, which was incorporated in October last, purchased the right to the patents at that time.

"Previous to that period they had never been brought into practical use by the inventors. Mr. Sawyer, one of the inventors, died recently. He was a dissipated man and during his life nothing could be done with the inventions.

"The various inventions which are included in our electric light system are essential to the system of electric lighting—in fact, they form its entire foundation. Our system includes the safety-switch, which all the companies are obliged to use, as the Board of Underwriters insist upon its adoption. It is used to switch off the current when it reaches a certain intensity.

"The board provides that the electric current upon entering a building shall not reach above a certain degree of intensity. When it goes above a specified point our switch cuts it off. Another, the treatment of carbon, is a valuable invention, and the method of exhausting the oxygen from the globes is used by all the companies, and is our invention.

"This system was invented and patented before any of the present electric lighting companies were in existence, and we claim the sole right to it. The fact that it was not brought into practical use by the patentee until now will have nothing to do with the validity of our patent. We have the letters patent in our possession, and they are duly recorded in the Patent Office Department at Washington.

"This suit involves an important question. Since the patents were taken out by Messrs. Sawyer and Man, a number of electric light companies have sprung into existence and are doing a remunerative business by using our inventions. They are using our inventions and making money which rightfully belongs to us.

"It is now our determination to seek what recompense the law will give us. Of course the validity of our claim remains with the court to decide. If the inventions rightfully belong to us we want them; if not, we want to know it. It will be a long and hard legal fight, but we hope to eventually establish our rights."

Mr. Edison, when interviewed in regard to the suit, laughed heartily and said:

"There is nothing in this. Let me see—what company is this? The Consolidated Company—never heard of it before. So they claim that we are infringing their patents, eh? They have nothing whatever to do with our system of electric lighting. There is just as much difference between our system and theirs as there is in a mill that is run by water and one that is run by steam. The steam power is far superior to the water power, and that is where our system comes in.

"This Sawyer and Man system is no good. They have never been able to make it work. They can't run one of their lamps fifteen minutes. They have been trying to sell the patent to me, but I don't want to be burdened with it.

"Sawyer is the man who challenged me a year or two ago. He said that my electric lighting system was a failure, and he did not believe that my lights would burn fifteen minutes. At that time my lamps had been burning 400 hours at Menlo Park. This fact, however, he questioned, and he challenged me to give a public test at his house, where he offered me the use of his wires and so on. He knew that his lights would not burn, and he thought that I was working on the same system that he was, and it was safe to challenge me. My system, however, is entirely different.

"This suit is a scheme to force the patents upon me. They have tried to sell them to me no less than six times. Now they think that by bothering me they can get me to take the patents and make about $10,000 or $15,000. But I don't want them."

A representative of the Brush Electric Light Company, at Broadway and Fourteenth street, also thought the suit laughable, and said:

"It is the first time I heard we were to be sued for infringing some one's patent. We have received no notice of it. Our system is our own, and we claim it to be the best in existence. We burn fifty lamps where the other companies burn but one. Why, we were contemplating bringing action against the other companies for infringing our patent, and now some one wants to sue us!"

Status of the Mexican Telephone Company.

By invitation of stockholders of the Mexican Telephone Company, President Delano, of that company, delivered an address on the company's work and prospects, at a special meeting held in Boston a few days ago. The meeting was attended by upward of 100 stockholders, including two ladies. There are in all some 600 stockholders, scattered over New England. President Delano gave a brief account of the difficulties under which the company had labored in Mexico, enumerating the more important obstacles which had been encountered, and, at last, almost wholly overcome. Former enemies had been converted into friends, and now the Mexican Company was in practically undisputed possession of the field. He did not believe that even at the expiration of the federal concession, five years hence, any other company could compete with it, should a concession of the renewal be denied, which he did not think it would be. The company had 321 instruments connected in the City of Mexico, and applications for 241 more, which were to be connected. Both Supt. Wiley and himself had no doubt that 1,000 to 2,000 subscribers could be had as soon as the instruments could be put in. The Mexican Company owns the territory in the State of Jalisco, in which is Guadalajara, the second city of importance in the republic. In that city there were 90 subscribers connected and 60 to be connected. The company was advised by a reliable informant that, by an expenditure of $300 in that city, 275 to 300 telephones could be put in use in Guadalajara, yielding a monthly profit of $1,500. The company had now reached a point where success was assured if the necessary funds were provided. The original capital, $100,000, had been exhausted, and there was a debt of $31,102.92, of which $10,000 was for services by Senator Lander and Mr. O'Gorman. The payment of one-half this amount was contingent upon the latter securing a concession for the use of poles. Telegraphic assurance had been received that the pole business was absolutely safe. This was very important, since without the right to use poles little business could be done. The right which the company bought to lay wires underground was of no practical use. The company needed $50,000, which would pay the above debt and leave about $19,000 for construction and to supply instruments for the sub-companies, in which the Mexican Company owns about 32,000 shares of stock, and for which it receives rental for instruments. The sub-companies were doing well. Director Welch said he had advices that the Mexican Pacific Company, of which he was president, would begin to earn dividends at the rate of 6 per cent. on $150,000 from July 1. President Delano said the $50,000 was needed immediately, and he favored a loan on the notes of the company rather than by a sale of the stock of the sub-companies, which was constantly appreciating. With the dividends and rentals from these companies, with 1,000 instruments in the City of Mexico, rented at $6 per month (it was now $5, but could soon be advanced), and with the Guadalajara exchange in full operation, he thought the company could in time show 10 per cent. net earnings on the common stock. Several plans for raising the money were suggested, including a loan on the com-

pany's notes, with the sub-company stocks as collateral; by the sale of the latter stocks; by the issue of bonds; by the issue of more preferred or common stock (there are now issued 100,000 shares of the nominal value of $10). It was finally decided to appoint Messrs. Bryant, Dennison and Garrison a committee to confer with the directors as to the best method of raising the money. Director Welch favored the issue of more stock, and offered to take 1,000 shares at 2½ on an issue of 20,000 or more.

Telephony in Philadelphia.

Mr. J. E. Zeublin, general manager of the Philadelphia Bell Telephone Company, has published an appeal to the members of the Select Council of that city, in relation to an oppressive ordinance before that body. The paper is of general interest. In it Mr. Zeublin says:

"Before final action is taken upon the amendment to the bill granting privileges on city poles to the Philadelphia Bell Telephone Company, introduced last Thursday, permit me on behalf of this company to call your attention to its injustice, and demonstrate to you its prohibitory effect in depriving thousands of citizens of the comfort, convenience and protection of the telephone in their homes.

"We have only asked for like privileges granted to every telegraph and electric light company, foreign and local, that has ever entered this city. We agree to pay the same high rate of taxation, and thus largely augment the city's revenue from that source, although our wires cause infinitely less strain upon the poles and weigh much less than those referred to.

"In addition to what you exact of them, you require us to furnish twenty-seven telephones to the various city departments and offices, to connect them with the general system and to employ operators to attend to that service without cost to the city. To this we will not object, if the city will furnish the necessary wires upon its poles without cost to us, for this service.

"You allow us this pole privilege for the brief period of eighteen months, when, by a law of your own making, we are compelled to place our wires underground, at another and greatly increased expense.

"We have asked this particular privilege in order to introduce telephones into *the residences* of Philadelphia at the low rate of $60 per year. Each subscriber to be connected with the 2,500 subscribers to the general exchange, and with the police and fire departments, enabling him to thoroughly protect his property under all circumstances, without risking his life or leaving his hearthstone.

"For this you make an annual charge of 50 cents per pole for each wire and a mileage tax of $2.50 for each mile of wire, aggregating $22.50 per mile, or three times the original cost of the wire; or, reckoning thirty wires to the pole, the number we would doubtless average, five times the original cost of the pole.

"With this average number of wires upon the city poles, the city would derive an annual revenue of $60,000 for attachments and $7,500 for mileage, or $67,500 in addition to the tax now paid.

"Philadelphia stands alone to-day as the only city in the United States that has not assisted in the development of its local telephone company by granting to it liberal pole and wire privileges.

"It is the only city that has baffled telephonic growth by unreasonable restrictions.

"It is the only city in which the *residence* telephone service is undeveloped.

"It is the only city in which the telephone has been refused pole privileges.

"It is the only city in which privileges on city poles have been denied.

"It is the only city that levies an onerous tax upon this industry. It is the only city that has demanded free service for all of its officers, and the right to regulate the charges of a private enterprise, developed entirely and with pre-eminent success without public aid. We come to you respectfully and frankly say to you that we cannot extend this service to the residences of this city at the low rates offered by us, unless we have the right to use the city's poles until a feasible and reliable underground service is developed.

"We object to the attempt to regulate our 'residence' and 'office' rates for the following reasons:

"1. Our rates, as shown by the annexed official comparative table, are now lower than those of the three leading telephone cities of the United States—New York, Boston and Chicago—the only cities with which a fair comparison can be made. In all of which free pole privileges are enjoyed.

"2. Our rates are relatively as low or lower than any city with a population of 150,000 inhabitants.

"3. A reliable and satisfactory residence service cannot be furnished, with any profit to the company, at a rate less than $60 per annum where such a tax is imposed.

"4. Limiting the number of calls and charging for extra service, as provided in the amendment, has been repeatedly tried in our commercial cities and abandoned. In Boston it caused a withdrawal of 50 per cent. of the subscribers within three months.

"5. Because our business service is already covered by satisfactory and expensive fixture routes on house-tops, through private arrangements made with the owners, your poles in that section being useless to us, as the induction from the electric light wires upon them compelled us to abandom them some months since, in order to work our business circuits.

"6. The new system requiring an extra and expensive wire run into all subscribers' offices, for which the companies are charged an additional royalty, has, on account of the increased expenses, been introduced in New York and Philadelphia only. The rate charged in the former city is $210 per annum, and but $120 in the latter, which is the same rate charged for the old system in Boston, and less than exacted in Chicago.

"Telephone experts who have visited every exchange in this country acknowledge that Philadelphia has the finest system and promptest average service in the United States. Facts demonstrate that, at a reasonable rate, we cover a larger area, with more impediments, with a greater population, than any exchange in the country, and we feel that it would be very unjust to tamper with our present and promised rates while a heavy tax is levied, and the additional and unknown expense of underground service is so nearly upon us.

"We beg of you, gentlemen, not to be misled by clamor, or the sophistical and unwarranted statements about our profits, or to continue to confound us with the American Bell Telephone Company, of Boston, the parent company, from which we lease our telephones, and the small territory that we operate, *exclusively* in Philadelphia, but to treat us solely and impartially upon the merits of our contemplated service and the reasonableness of our request."

The Edison Electric Light Company's Work.

The *Evening Post* of this city says: The latest "bulletin" issued by the Edison Electric Light Company states that the number of houses now lighted from their down-town station in Pearl street is 429, in which are 10,268 lamps. The six dynamos in the station are capable of running 7,200 lamps at one time, but in an office building it is not likely that more than half the number will be burning at the same time, and in private houses the average of lights needed will not exceed 5 or 6 out of a possible 25. Nearly double the number of lamps now in the down-town district can therefore be connected with the station without overtaxing the current-producing power of the dynamos. The average monthly increase in the number of lamps is about 500.

Major Eaton, president of the company, says it is proposed to extend the field of the down-town station by running wires along the east side of Broadway, from Fulton to Wall streets, thus taking in a large number of valuable office buildings. The machinery at the station is now working with satisfactory smoothness. As to the cost of the light, Major Eaton believed many persons had complained that the new light cost them more than gas, because they wanted to get cheaper rates for electricity than they had been paying for gas. Moreover, from October till January no charges for electricity were made, so that every one got to be extravagant in using the light. The present charge is estimated to be at a rate equivalent to that of gas at $2.25 a thousand cubic feet. The Edison Company is, according to Major Eaton, entirely satisfied with the present position of affairs, and a dividend at the end of the year is mentioned, the company now making money and expecting to make much more when the whole plant is in use.

Within the last three months Mr. Edison has made two important inventions relating to electric lighting. The first is a new arrangement of the magnets of his dynamo by which at the same cost and with no more weight of iron and brass the result is double what it formerly was, provided, of course, that the steam power is doubled. Thus a twenty-eight dynamo, if rearranged by this new method, gives current for forty lights by doubling the steam power. As the expense of the dynamos is large, the possibility of doing the same work with half their number improves the situation considerably, and in a number of stations to be established within a few months in other cities the new dynamos are to be used entirely. Mr. Edison's second improvement concerns the method of distributing the current through the street mains. By the use of three wires instead of two he is enabled to use lighter wire, and save about half the expense of copper. If he had known two years ago what he knows now about city stations he could have saved, he says, 60 per cent. of the large cost of the Pearl street station. The Edison Company announces that before January, 1884, there will be twenty different Edison stations in as many cities and towns well under way, or in operation.

Misdirected Inventive Genius.

Texas Siftings preaches the following sermon on the genius and energy inventors expend to little purpose:

Professor Lendstrom, a German scientist, climbed a Spitzbergen mountain the other day, and by the aid of some long wire rods, a battery, some insulators, acids and bad-smelling drugs, manufactured an aurora borealis. It is true that it was not a very large one. It was described as being "about the size of the gable end of a two-story house."

The scientific world is excited over this achievement of Professor Lendstrom. The professor acknowledges that his aurora is not perfect yet. It is a little ragged at the edges and inclined to warp and shrink in dry weather; but he claims that he will soon be able to produce a borealis exactly like the genuine article furnished by nature and equally as good.

What use Professor Lendstrom can make of an aurora borealis we cannot see. You can't eat one of them. It is not a substitute for tobacco. Neither is it a stimulant nor a cure for chills. It is not a labor-saving machine. The professor cannot pull his boots off at night with his aurora borealis, nor use it as a corkscrew, nor fry a rasher of bacon on it.

There might be some point in manufacturing aurora borealises if they would run machinery, poison rats, or grub up roots on the farm; but they do not seem to accomplish anything, and even if they did they could not be sent to purchasers by mail, and if forwarded by express the freight would eat up all the profit, and ruin the borealis industry. We deprecate these investigations into the realms of natural science. First thing we know scientific men will be working up schemes to manufacture all kinds of natural phenomena, and the day may not be far distant when the poorest in the land may be able to own a cyclone, or a transit of Venus made to order, and earthquakes, eclipses, and waterspouts of assorted sizes will be manufactured, warranted to be equal to the genuine, and to keep good in any climate, and no one will be too poor to set up a private collection of rainbows in his own back yard. But we do not think that this will add to the wealth of the country. If these scientific men would go to work inventing ways and means to make buttermilk without the aid of a cow, or should discover means to make imitation gumboils, or other valuable articles of commerce, they would confer a benefit on the public, and generations yet unborn might call them blessed; but an aurora borealis factory is not what the people of this country yearn for.

Telephone Progress in Ohio and Kentucky.

[From the Cincinnati Commercial Gazette.]

Captain George N. Stone, general manager of the Telephone Company of Cincinnati, has arranged to construct a line from Cincinnati to College Corner, Butler County, Ohio, there to meet the Midland Telephone Company from Indianapolis, making up a through line between Cincinnati, Connersville, Ind., and Indianapolis. He has also arranged to construct a line from Cincinnati to Williamsburg, O., to meet the Midland Company with a line from Georgetown, O., making a through line between Cincinnati and Georgetown. He has also arranged to construct a line from Cincinnati to Carrollton, Ky., there to connect with the Louisville Telephone Company, thereby making up a through line from Cincinnati to Louisville, Ky.

The captain has also arranged to construct a line from Cincinnati to Cynthiana, Ky., to meet the East Tennessee Telephone Company with a line from Frankfort, Ky., via Lexington and Paris to Cynthiana, thereby making up a through line between Cincinnati and those points.

Captain Stone also has under consideration the construction of a line to Harrison, O., and one to New Richmond, O.

The line through Cincinnati, Lexington and Paris, Ky., will also put Cincinnati in communication with Knoxville and Chattanooga, Tenn. It has been agreed that the East Tennessee Company shall build a line direct to Cynthiana, another direct line from Lexington to Cynthiana. The Midland Company has agreed to build a direct line from Indianapolis to College Corner, and another direct line from Georgetown to Williamsburg.

The Louisville Company has engaged to do the same thing, making a direct line to Carrollton. These direct lines are absolutely necessary in order to prevent interruption in messages by switching.

The Telephone Company of Cincinnati now has telephone communication between 160 towns and cities and this city.

The Difficulty in Operating Electric Railways.

The great obstacle in the way of success of electric railway enterprises is ground connections which lead the current off the rails, thereby destroying the motor power. Even if practically perfect insulation of the rails is secured, it is hard to maintain, for a shower of rain, or a metallic, wooden or earthy body of ordinary conductivity, will establish a connection with the ground when coming in contact with the rails. On the Berlin electric railways, constructed by the Siemens Bros., the idea of securing a satisfactory insulation was given up after repeated trials, and the current is now sent through wires overhead instead of through the rails. Now, however, the Daft Electric Company (or its chief engineer), who has been running electric motors on a horse car line reaching from Newark to Bloomfield, claims that by a peculiar subdivision of the dynamo used a current of low tension is obtained, which is automatically switched out and in, according to the work demanded of it. Thus the tension of the current is so low there is no necessity for insulating the tracks at all when using them for the electric current. "So long as there is no metallic connection between the two tracks, the dynamo producing the current does not work. Establish a connection through one of the motors on the track and the dynamo becomes active, and the motor on the track leaps forward."

We should think that if perfect—practically considered—insulation is desired, it might be obtained by the use of glass cross-ties on electric railroads. We do not know whether glass ties have ever been experimented with or not, nor do we know whether the idea is feasible. Could glass be used in this way, however, there would be no question as to the insulation of the track.—*Age of Steel.*

Average Practical Dabblers in Electrical Science.

To the Editor of The Electrical World:

SIR: The answer to Mr. Ball in THE ELECTRICAL WORLD detracts nothing from the dignity of "C. O. M.," and suggests a hint to a large class who are actively engaged in electric pursuits. It is quite common to hear these persons, who are indebted to circumstances for the opportunity of manipulating electrical apparatus, speak of the expositions of eminent scientists with the greatest disdain. They are usually average practical men, who never consider that their actions are based upon the teachings of the "newspaper men," whom they aspire to ridicule. The theory of the conservation and correlation of forces is to them the idle speculation of men who are not practica

consequently irresponsible. Such men, if their constructive faculties are active, will be found exploring the perpetual motion field and combating natural laws in an endeavor to revolutionize modern appliances. On account of their narrowness of mind they are suspicious of everybody. In their opinion newspapers are corrupt mediums used by cunning men to dupe the public. This class is too numerous. Presumably it is an important per cent. of the whole national body. An antipathy to literature is the misfortune of such people, and they never realize the amount of labor necessary to collect and systematize the valuable experience and expressed thoughts of intelligent workers. C. J. M.

EVANSVILLE, Ind., June 15, 1883.

DEPARTMENT OF INQUIRIES.

35. THE DOUBLE-INDUCTION MOTOR.

Referring to the double-induction motor, described in THE ELECTRICAL WORLD of April 28, will you please answer the following questions: Is the cylinder made in two sections, and is a space left between each; or is there a space merely between the two sections of wire? What size wire on armature and field magnets; how wound and how many layers on each? Will you please give me a short description of armature? J. W. C.
MASSILLON, Ohio.

The cylinder is cast in one piece, the wire being wound at two opposite points so as to leave a space between the two sections. The wire is No. 18 or 20, and is wound in three or four layers. The iron which corresponds to the space between the two coils and forms the poles of the cylinder projects inward, so as to be even with the wire inside the cylinder. The armature is the same as that used in the old Siemens dynamo-electric machine, and will be found described and illustrated in *The Operator* of Dec. 9, in "Electric Lighting, VII." In this machine the armature is made rather larger in diameter, proportionately to its length, than in the Siemens machine. The wire in this motor is about the same size as that used on the field magnets.

36. ELECTRO-MAGNETIC ENGINES.

Can you refer me to any descriptions of electro-magnetic engines with a reciprocal motion, giving dimensions, weight and power, etc.? I have heard of such engines having been built by Professor Page, of the Smithsonian Institute, in 1852, and M. Bourbouze, in the old country, but I do not know the date. Can you also tell me about an electro-motor built in England in 1844 and 1849?
CHICAGO, Ill. S. T.

The earliest mention of an electric engine having a reciprocal movement is in 1844, when M. Froment constructed a machine in which an armature moved in front of two poles just like the armature of a vibrating bell. This armature was attached to a crank shaft. There was only one positive motion which was that produced by the attraction of the armature. The momentum of the fly-wheel of the engine was depended upon to move the armature away. The motor of Professor Page, invented in 1850, depended upon the attraction of a hollow coil for an iron armature. In 1851, M. Du Moncel also invented a motor constructed on the same principle. Both are described and illustrated in this number of THE ELECTRICAL WORLD. A motor was also invented by M. S. Hjorth, in which an iron armature moved into a hollow coil up and down, there being two sets whose crank shafts were on opposite sides of the diameter of revolution, so that one was always acting while the other was inert. The motor of M. Bourbouze was invented about 1851, and is also illustrated in the present issue. The motor of M. Du Moncel, which is a reciprocal, was invented about the time. Messrs. Pellis and Henry also invented a reciprocal motor about that time in which the pole pieces of the magnet were in the form of cones, working in corresponding cavities of the funnel-shape of the armature. Almost all these motors, except that of Mr. Page, were experimental, and no data as to dimensions, power, etc., exist concerning them.

37. HUMMING IN TELEGRAPH WIRES.

What will stop the humming sound that goes over a wire on a very cold night when it is crossing a house? A wire crosses our house, and the annoyance is so great as to disturb sleep. I would like to be informed. S. F. D.
YANKTON, Dakota.

The noise is produced by vibration of the wires in consequence of the action of the winds, or oftentimes by the trepidations of the ground, due to various causes, which set the poles in vibration, and these transmit the vibration to the wires. There are several ways of remedying the difficulty, all depending on the same principle, namely: to provide an elastic cushion of some sort that will prevent the vibrations from being transmitted along the wire. Sometimes by wrapping a piece of India-rubber around the pony insulator, before the wire is fastened to it, the annoyance is entirely overcome. In other cases the wire is cut between two poles, and the ends are passed through a solid piece of India-rubber as if to make a swivel joint, though the two rods are not in contact, and a separate piece of wire is then used to form a connecting loop around the rubber joint. In still other cases the wire between two poles may be twisted around a piece of India-rubber. The function of the India-rubber, in all cases, is merely to make the line yield at that point to the vibrations. If it did not yield the tension produced on the wire at each vibration would be conveyed along further.

THE TELEGRAPH.

CHINESE TELEGRAPHS.—The Chinese government has issued an edict to the effect that the telegraph lines from Woosung to Shanghai and from Amoy to "Hoihon" shall be built by the Chinese alone. The Great Northern line will only connect up to a point contiguous to the outside ports.

UNDERGROUND WIRES.—The special committee of councils in Philadelphia, to whom was referred the ordinances granting permission to lay underground telegraph wires in certain streets, agreed on the 6th to report the ordinances to the general committee with a favorable recommendation.

A DECISION ON INFRINGING PATENTS.—In the action of the Gold and Stock Telegraph Company against Charles J. Wiley, founded upon the alleged infringement by the defendant of reissued letters patent granted Jan. 25, 1870, to the plaintiffs as assignees of Edward A. Calahan, and of original letters patent granted July 27, 1871, to Henry Van Hoevenbergh, as inventor, Judge Shipman, in the United States Circuit Court on Saturday, handed down a decision in favor of the plaintiffs touching the Calahan patent. The original Calahan patent was granted April 21, 1868, and each patent is for an improvement in telegraphic printing instruments particularly designed for registering the prices of stock. After reviewing the testimony, the judge orders a decree for an injunction against the infringement of the Calahan patent and for an accounting, and the dismissal of the bill so far as the Van Hoevenbergh patent is concerned.

THE WESTERN UNION SUIT IN ILLINOIS.—The demurrers to the amended pleas in the quo-warranto case of the people against the officers of the Western Union Telegraph Company were argued on June 13, before Judge Gary, of Chicago, at some length. The first plea of Williams & Thompson, that they merely acted as attorneys of the company and under its direction, the Judge held good, and overruled the demurrer thereto. The other pleas of the officers of the corporation, that the company was a New York corporation and operated in Illinois through the comity of States, and that its official existence could not be terminated by proceedings in Illinois, the judge held to be bad, because they failed to show what the New York law was and how it was organized, and what authority those laws gave to the business in Illinois. The plea that the company had been recognized by the Legislature of Illinois because an act had been passed changing its name was bad, as being argumentative, and it was only an inference therefrom that the defendant was a corporation. The plea containing the averment that the company had accepted the provisions of the act of Congress relating to post-roads was also bad, because it failed to show that the company was only using post-roads and the precise authority conferred on it by such act. The demurrer would be sustained as to all but the first plea, and five days be given in which to file two amended pleas."

THE TELEPHONE.

CHATTANOOGA uses 158 telephones and is putting up more.

TELEPHONE TRANSMITTERS should be painted "yeller."—*Boston Commercial Bulletin.*

IOWA.—Boone and Des Moines are now connected by telephone. Cedar Rapids, Waterloo, Cedar Falls and Independent are being connected.

A CINCINNATI HARDSHIP.—When a Cincinnati man simply forgets himself to the extent of reversing the "Hello" shouted into his telephone, the cruel monopolists call it swearing, and deprive him of the use of the instrument.—*Cincinnati Commercial-Gazette.*

THE TELEPHONE IN NEW ZEALAND.—A correspondent in Wellington, writing under date of May 3, says: "Telephone exchanges are in operation in Wellington, Christchurch, Dunedin and Auckland, New Zealand, and Edison-Bell telephones, with Blake transmitters, are used. We have about 700 subscribers thus far, but we expect to reach four figures in a short time.

ANOTHER LOWELL PURCHASE.—The latest purchase by the Lowell syndicate consists of the Erie T. &. T. Co.; capital $1,000,000; at present 1,500 subscribers; operating Cuyahoga County, Ohio. The new territory includes Cleveland, which has a population of about 210,000, and the plant is said to be one of the mest perfect and best constructed in the country. Under Lowell management it is believed that this new territory is capable of a development equal to any that has been thus far acquired.

THE LOUISIANA TELEPHONE COMPANY.—The sale of the stock of this company, mentioned last week, was completed on the 12th and the cash paid by the purchasing company. Mr. E. S. Babcock, Jr., of Evansville, Ind., was elected president, *vice* Mr. John N. Bofinger, who was chosen vice-president and general manager. Capt. Paul J. Marr, of Nashville, Tenn., was elected director, *vice* Mr. W. W. Huck, who remains with the new company as secretary and treasurer. It is said that to Messrs. Bofinger and Huck is due the success of the telephone service in New Orleans heretofore.

THE LOWELL COMPANIES.—The telephone companies under Lowell management made the following net increase of subscribers during the month of May:

	Added.	Now Connected.
Nat'l Bell of Me.	36	3,916
Boston & Northern	169	3,329
Bay State	116	2,705
Surburban	88	1,390
Union	20	550
Northwestern	322	1,842
Granite State	3	426
	752	13,958

The Southwestern Company has about 2,800, with orders for about 400 more, making a total under Lowell management of 16,758.

THE TELEPHONE IN MARYLAND.—A Frederick (Md.) correspondent writes: The telephone exchange company's business in Western Maryland is assuming extensive proportions. At Cumberland the exchange numbers about 200 subscribers, with connections to Vale Summit, Frostburg, Borden Mines, Lonaconing, Ocean Pekin, Barton, Phœnix, Westernport, Bradys and Rawlings. At Hagerstown (60 subscribers) lines are up to Williamsport, Chewsville and Smithsburg, and other towns are being rapidly connected. At Frederick the exchange will be opened July 1 with 75 subscribers, the wires to be extended over the entire county. All the business of the Telephone Exchange Company in Maryland, outside of Baltimore, is in charge of Mr. John A. Blattau, superintendent, and the entire system is thoroughly well constructed, using the best of modern appliances throughout.

PROFESSOR BELL'S COURTSHIP.—Mrs. Bell, wife of Prof. Graham Bell, the electrician, was one of the deaf pupils of Dr. Gallaudet in Washington. Professor Bell first met her at a reception at the college, and so expert was she in reading speech by the motions of the lips that they conversed together for some time without his discovering her infirmity. At last, walking through the conservatory where some of the Chinese lanterns had gone out, he made some remark requiring an answer. But none was forthcoming, it being not light enough for her to see the movements of his lips. He repeated the remark and again got only silence for reply. Mystified, he soon escorted her back to the parlor, and then, in the brilliant light, asked her why she had not answered him, but his amazement was redoubled ten-fold at her ready reply, "I have never heard a sound in all my life."

TELEPHONE WORK IN TEXAS.—The management of the newly-reorganized Southwestern Telegraph and Telephone Company, headquarters at Lowell, Mass., was in consultation with subordinate officials of the service in Arkansas and Texas last week. The service for these two States has been arranged into conveniently subdivided territory, called districts, one extending east and west from El Paso to Marshall, and from Waco northward, with headquarters at Dallas; another taking all of Arkansas and that part of Texas eastward from Marshall, with headquarters at Little Rock; and the other comprises the balance of Texas, with headquarters at San Antonio. There are now seventeen established exchanges in Texas, and during the year at least a dozen more will be in operation. Nearly 200 additional miles of wire will be put up at once in the territory tributary to Dallas. A special fund of $200,000 cash is now on deposit for that and other extensions in Texas.

A NEW COMPANY TO USE THE HOPKINS TELEPHONE.—A license was issued at Springfield, Ill., last week, to the Inter-State Telephone and Telegraph Company of Chicago. The incorporators are Allan C. Story, Allan C. Knapp and Charles Whitlock. The capital is fixed at $500,000. Mr. Story says the object of the new company is to introduce the improved long-distance telephone, which is operated on the make-and-break instead of the undulatory plan, and which we have already described. Mr. Knapp is manager of the Board of Trade Telegraph Company, and Mr. Whitlock represents the inventor of the new instrument. The word "Inter-State" is inserted because the new telephone is designed to operate over long distances, like the present telegraph system. Mr. Story is confident that the enterprise will find all the financial backing it may require.

THE TROPICAL TELEPHONE COMPANY.—Mr. Judson Shute, agent of the Tropical Telephone Company, has returned from Brazil, bringing the important contract with the "Companía Nacional Electricidade" for the entire empire. The former, it will be remembered, transferred to the latter all of its rights in Brazil, including letters patent to Alexander Graham Bell as the first and only inventor of telephony, and the latter thereby secures a monopoly of the telephone business in the empire and exclusive importation privileges. Already several lots of telephone goods have been embargoed in stores and on board vessels bringing them into Rio and other ports for violation of the company's concession. The above contract is estimated to be worth at least $8,000 or $9,000 per year to the tropical company outside of its ownership of 100,000 shares (one-fifth of the whole) of Nacional stock and the cash consideration in the trade heretofore mentioned.

STILL ANOTHER NEW TELEPHONE COMPANY.—The Union Central Telephone Company has been incorporated in Illinois. The incorporators are Robert C. Clowry, De Lancey H. Louderback, and Charles S. Holt. The capital stock of the company is $6,275,000. Regarding the aims and intentions of the new corporation Mr. Louderback says the principal object is to work undeveloped fields in Indiana, Ohio, Iowa and in Illinois outside of Chicago. They will also make a specialty of connecting county-seat towns with outlying towns in their counties, but will attempt nothing in the way of long-distance connections. "I am not convinced," said Mr. Louderback, "of the practicability or utility of connecting cities long distances apart by telephone; but I am certain there is much to be gained from a commercial standpoint by connecting county seats and their suburban towns. For instance, a county seat may be so small as to barely pay to establish an exchange in it, yet when you connect it with other towns in the county you gain customers and make the exchange doubly valuable in a commercial way. This is what we intend to do; at least that is our object at present. We have no stock for sale, and are not yet in shape to say any more about our plans and intentions."

BELL TELEPHONE STOCK.—The Boston *Herald* says: "The Bell people do not allow that they are disturbed by the Drawbaugh suit, and value their own property quite independently of this matter. The company, they argue, is honestly and ably managed. Its only debt is $600,000 in bonds, which will be converted into stock within a year. Its expenses are likely to remain practically stationary. An increase of 13 per cent. in earnings is anticipated for several years from dividends of the local exchange companies, without any increase in the number of telephones used. But there is an increase of about 25 per cent. per year in the use of telephones, and it is calculated that if even a less ratio of increase is maintained that the net yearly earnings of the company will be over 50 per cent. on their stock. That the future of the telephone business was never so promising as now goes without saying, and it is peculiarly true that possession of the field in this business is several, if not the proverbial nine points of the law; but investors in telephone securities can without harm bear in mind the possibilities of rivalry, of improvements and of legislation, which might reduce the profits without destroying the usefulness of the invention. The same business principles which are applied to other investments can properly be applied here."

THE ELECTRIC LIGHT.

WALLACK'S and the Madison Square Theatres of this city are to be lighted with the Edison light.

THE ELECTRIC LIGHT IN JAPAN.—The Japanese, ever on the alert for improvements, are making arrangements for introducing the electric light at Yokohama.

THE LIGHT AND THE SUEZ CANAL.—M. De Lesseps has announced that the Suez Canal Company will hereafter light the line of the canal with electric lamps, so as to aid travel and to an extent prevent the overcrowding of the canal with vessels.

ELECTRICITY IN THE LIGHT-HOUSE SERVICE.—The Light-house Board is arranging for a series of experiments with electric lights at the station on Staten Island, and has already given orders for lens and other electric apparatus. It is proposed to adopt the electric light in the light-house service if it should prove superior to the present system.

THE EDISON LIGHT IN SCOTLAND.—A new steamer, called the Clan MacArthur, just launched on the Clyde, is lit throughout with incandescent lamps by the Glasgow branch of the Edison Electric Light Company. It is said that the owners have been so pleased with the complete success of the lighting that they have placed the lighting of another steamer, the Clan MacIntosh, with the Edison Company, without inviting tenders from other firms.

A CONTRACT FOR THE MAXIM.—The contract between the Maxim Electric Light and Power Company, of Philadelphia, and the Lamp Committee of City Councils of Lancaster, Pa., has been signed. The Maxim company agrees to have sixty lights in position and lighted by August 10, and sixty additional lights by September 10 The company filed a bond in the sum of $10,000 for the faithful performance of the contract. That number of lights costs the city $16,800 per year.

POLES AND RIGHTS OF PROPERTY.—Judge Donohue of the Supreme Court, on the 16th, granted a temporary injunction restraining the United States Illuminating Company from erecting poles opposite houses numbered from 1,310 to 1,320, on Third avenue, in this city. The owner of the property claims that the company has no legal right to erect poles, having authority only to erect lamp posts. Accompanying the temporary injunction is an order directing the company to show cause on the 27th inst. why it should not be made permanent.

THE HEAD-LIGHT NOT TO GO YET.—A story has been going the rounds to the effect that the Pennsylvania Railroad Company would shortly introduce the use of electric lights all along its line between this city and Philadelphia, and so do away with the time-honored head-light. Superintendent Pitcairn says there is not a word of truth in the report. Electric lights cost not less than fifty cents each per night, and a head-light can be supplied with enough oil to last a month for the same money. For this reason the change would be one of the most expensive improvements yet introduced by the P. R. R.—*Pittsburgh Leader.*

ATTEMPT TO REMOVE THE BRUSH COMPANY'S POLES IN PHILADELPHIA.—In Philadelphia, on June 12, Judges Hare, Mitchell and Fell heard argument in the suit brought by the commonwealth at the instance of the Board of Trade of that city against the Brush Electric Light Company to secure the removal of the poles and wires erected by the company upon Chestnut and other streets. It was argued that the poles were such an obstruction to the public highways as city council has no right to authorize. In answer to this, it was contended that the light was in the nature of a public convenience, which it was the duty of both councils and court to protect and encourage. The court reserved its decision.

A FORTUNATE ELECTRIC LIGHT MAN.—A correspondent writing from Evansville, Indiana, says: "Mr. E. J. O'Beirne, now in our city superintending the building of electric light towers, has been granted a patent on the use of star iron for tower material. This popular young gentleman recently returned from Macon, Georgia, where he built ten electric light towers and improved his leisure moments in planning the successful capture of a Southern belle who acknowledged her willingness to be called Mrs. O'Beirne. What with his new business and domestic prospects Mr. O'Beirne looks complacently down from the top of one of his highest contemplated towers on the struggling masses who are striving to obtain elevated eminences. May his ambition to rise above us increase the brilliancy of his genius to an extent that will eclipse all candle-power capacity."

ANOTHER SHOCKING AFFAIR.—A Chicago paper tells the following somewhat highly-colored story: "At the main entrance to the exposition there hangs an electric light, which appears to be one of the worst man-traps in the city. The light, being only a few feet from the ground, seems to afford the visitors an excellent opportunity for investigating the wonders of electricity. Two strangers, evidently from the country, stepped up to this light and examined it minutely. One remarked that the globe was cold, and this led the other to grasp the iron side rod which holds the globe in position. The effect was truly wonderful. The man was jerked completely from the ground, yelling like a wild Indian. In his endeavors to catch some support, his hand encountered the shoulder of a bystander which divided the power of the shock, enabling the victim to let go. A crowd of firemen and policemen immediately crowded round, kindly giving hints that he was fortunate to get off with his life, others showing statistics regarding men who had been killed in that way."

NEW BRUSH COMPANIES.—The daily *Arizona Journal*, published at Prescott, Arizona Territory, states that the Brush-Swan Electric Light Company of Prescott has just been incorporated. Its directors and stockholders are among the most prominent men of Prescott. The capital stock of the company is fifty thousand ($50,000) dollars. This company was organized by Mr. T. F. Cronise, agent of the Rocky Mountain Electric Light Company, the headquarters of which are at Salt Lake City, Utah. The Norfolk *Virginian* states that a charter of incorporation has been granted to some of the leading men of Norfolk, Va., for the Brush-Swan Electric Light Company, which will operate in the city and county of Norfolk, in Portsmouth and in Princess Anne County. Under the laws of Virginia the minimum of stock is to be ten thousand ($10,000) dollars, and the maximum two hundred thousand ($200,000) dollars. Both of the companies named above will at once order apparatus and prepare to fill orders for Brush electric lights.

THE ELECTRIC LIGHT AT BUCKINGHAM PALACE.—The London *World* says: "On Tuesday night the first Queen's ball took place and will be remembered as the occasion on which the electric light was introduced into Buckingham Palace. Its general effect was good. Handsome uniforms fared the best, and many toilets which had seen no service were able to stand the searching light, but it will certainly be necessary to fit up private houses with the new illuminator if ladies are to know the precise shades of color in which they are destined to appear. As to complexions, the less said about the change from the soft light of wax candles the better. The light was steady and gave no signs of flickering or collapsing, but it was very curious to leave the room thus lit and turn into any of the other apartments, which, though lit with innumerable lights, appeared to be in comparison enveloped in darkness, and this gave a dull effect to every other part of the palace. Some complain that the result of an evening in electric lighted rooms is a violent headache next day, but the authorities generally approve the new plan, so it will be continued and perhaps extended.

ELECTRIC LIGHTS IN THE CHANNEL TUNNEL.—A writer in the *London Daily Telegraph* has made a trip through the channel tunnel in a "trolly." The tunnel is twenty-two miles long. He says: "The travelers, for the greater length of time, moving through a dim twilight, cannot well make out the features even of those who sit beside them. Now and again the little electric lamps, set in rude niches of the naked gray chalk, cast a brilliant but fugitive light on the passing train. Then, for awhile, all is again but darkness visible. There are shadows above and beneath, and all around. Looking backward or forward through the deepening gloom the traveler sees an ever receding, seemingly endless funnel-shaped perspective, lit at long intervals as with fiery eyes. Sometimes in the fitful flashes of light the eye rests upon falling red rivulets, like streams of blood, pouring down the damp walls. Ever and anon there are "faults" in the clayey chalk not yet remedied. So we go on and on, moments seeming as minutes, until the electric lamps cease altogether, and the long, awful cave is enveloped in a darkness which would be impenetrable but for the glimmer of a few tallow candles stuck into the bare walls of the cutting.

ELECTRIC STREET FUN.—A crowd of men and boys gathered on the sidewalks in Maiden lane, between Nassau and William streets, on Saturday afternoon of last week. At frequent intervals somebody would exclaim: "Here comes one!" and then everybody would smile with pleasurable expectation and turn their eyes toward an approaching horse and truck. The driver, meanwhile, with that air of supercilious indifference peculiar to his class, would scarcely deign to notice the crowd or remove his gaze from his jogging beast. Suddenly, when his horse reached a certain spot in the street pavement, the animal would give a spavined and convulsive leap, shake up the driver with a violent jerk and continue on his way at a lively pace. Then the crowd would laugh and the driver swear. When a team came along sometimes only one horse would be affected, but the pair always jumped ahead in rattling style. These phenomena invariably occurred when the horses reached the same spot in the street pavement. The underground electric light wire had become disarranged, and a metal plate in the roadway was strongly charged with electricity, so that when the iron shoe of a horse touched it the animal experienced a severe shock. The fun lasted until a policeman came along and warned drivers to take the side of the road.

MISCELLANEOUS NOTES.

THE FUTURE CANDIDATE'S BATTERIES.—An exchange says: Now that the application of electricity is known to accelerate the speed of animals, we may expect the future candidate to fairly bristle with batteries—in fact, he will be a regular shocking machine.

THE ELECTRIC CHAIR.—The new patent electric chair for the executions of criminals is, it seems to us, altogether too humane. The ordinary parlor chair, for instance, would furnish plenty of punishment of a more decided character.—*Lowell Courier.*

THE ELECTRIC RAILWAY.—Telegrams from Chicago say that the electric railway at the Railway Exposition is now in good running order and carries full loads of passengers. On Saturday last, with one car, 12,000 passengers were carried over the route in eight hours. At no time during this period was there any interruption.

A NEW USE FOR ELECTRIC BELLS.—A Cincinnati gentleman, who enjoys a late Sunday morning snooze, suggests that church tower bells be dispensed with, and as substitutes to summon people to church small electric alarm bells be placed in the houses of members. Thus sextons could get in their work without disturbing the whole town.

RATHER A SEVERE SHOCK.—When the wife of an Ohio politician was informed that he had been struck by lightning and killed, she didn't burst into a flood of tears. She merely remarked, "Well, I never would have believed there was anything in this world that would shock John."—*Philadelphia Chronicle-Herald.*

SPEECHES BY ELECTRICITY.—Speaking of the invention for registering votes by electricity, the Detroit *Free Press* says: This is a great step in advance and is an illustration of matter over mind—that is, congressional mind. A little further progress in this direction and we shall have electricity delivering speeches in Congress, which will be bright, quick and clear. The advantages of such a machine over those now in use at Washington scarcely need pointing out.

GRAY'S ELECTRICAL COLLEGE.—Concerning this enterprise, referred to in our last issue, Mr. Elisha Gray says: "I have not matured plans concerning the establishment at Highland Park. I have purchased the land between my residence, or rather on the north side of my park and the Northwestern Railway, for electrical purposes, it is true. But the only students to be admitted there will be the past graduates of colleges or advanced electricians. If I have a laboratory it will be on a much larger scale than Edison's at Menlo Park."

THE GREAT EASTERN.—London *Truth* says the Great Eastern, the largest steamship in the world, which has been in the telegraph cable service for several years, earned last year $65, while $20,000 was spent in keeping her in repair. The company having this mammoth white elephant on its hands is unable to "wind up," for, besides the original mortgage debt, not a shilling is due to any creditor. The directors are now considering a "proposition for employment," which will at least save the cost of maintenance; and it is hoped in the meantime that the "increased size of the ships which are now being built is in favor of the Great Eastern."

A PNEUMATIC TUBE TO CHICAGO.—A special dispatch from Chicago on the 18th says that a New York civil engineer is in that city as the representative of a company which has been formed in New York for the establishment of a pneumatic pipe line between that city and Chicago, for the purpose of transmitting letters, grain samples, jewelry and other small and light packages at a charge of five cents for letters and ten cents for parcels. Way stations are to be established at Cleveland, Buffalo and other points. The pipes will be of iron, four inches in circumference, and the cost is estimated at $4,000 a mile. A capital of $4,250,000 is said to have been subscribed. The boxes, which will contain the matter intended for transit, are expected to make the distance in four hours.

LIGHTNING WITHOUT THUNDER.—Professor John Tyndall, in a note to *Nature*, says: Looking to the south and southeast from the Bel Alps the play of silent lightning among the clouds and mountains is sometimes very wonderful. It may be seen palpitating for hours, with a barely appreciable interval between the thrills. Most of those who see it regard it as lightning without thunder—*Blitz ohne Donner*, *Wetterleuchten*, I have heard it named by German visitors. The Monte Generoso, overlooking the Lake of Lugano, is about fifty miles from the Bel Alp as the crow flies. The two points are connected by telegraph, and frequently when the *Wetterleuchten*, as seen from the Bel Alp, is in full play, I have telegraphed to the proprietor of the Monte Generoso Hotel, and learned in every instance that our silent lightning coexisted in time with a thunder-storm more or less "terrific" in Upper Italy.

STOCK QUOTATIONS.—Telegraph, telephone and electric light stocks were quoted on Tuesday of last week and Tuesday of this week as follows:

	June 12.	June 19.
American Cable	67½	68¼
Bay State Telephone	136	132
Bell Telephone	279½	271
Boston & Northern Telephone	163¼	160
Edison Electric Light Co	308	310
Granite State Telephone	90	....
Mutual Union Telegraph	19½	19½
Mexican Telephone	2¼	2⅝
National Bell of Maine	82½	....
Northwestern	64½	....
Suburban	140	....
Southwestern	63½	....
Tropical Telephone	2⅝	....
U. S. Electric Light	128	128
Western Union Telegraph	86½	87¾

THE ELECTRIC RAILWAY.—The Chicago *Tribune* says: The electric railway at the exposition, now that the mechanical difficulties have been overcome, is in successful operation, and in its way the event possibly should create as much wonder as the launching of Fulton's steamboat, and doubtless will hereafter be pointed to as marking a new era in railroading. The delay thus far has been owing to the clumsy construction of the road-bed and equipment, and in no sense to the motor, although the management debated a long while as to the motor to be employed and finally settled upon the Weston machine, controlled by the United States Electric Light Company, as the one most likely to furnish the greatest and most evenly distributed force. If any credit is to attach to the opperation of the railway it is to be given largely to the Weston machine as supplying the motive power. The United States Company in its exhibit at the north end of the great exposition furnishes another display of the power of the Weston machine by the pumping of a large body of water to a height of ten or twelve feet, which afterward resolves itself into a picturesque cascade.

AN ELECTRIC DYNAMITE SHELL.—Mr. F. H. Snyder, of Jersey City, has invented a shell which promises to eclipse all other missiles of war in destructive ability. The system combines the qualities of the multi-charge gun and the Russian dynamite bomb. A cartridge containing a large quantity of dynamite is constructed. Back of this, and separated from it, successive layers of powder are placed and so regulated by degrees of fineness and hydraulic pressure that they shall explode in successive flashes as the shell leaves the gun. By this device the inventor expects to get a velocity nearly 50 per cent. greater than is now possible. He expects also to ignite the powder by electricity, thus omitting the vent which, he says, causes much loss in the present system. The dynamite, he explains, is not exploded by a spark, but by a blow. Hence his shell will carry its hundred pounds of dynamite without an explosion until it strikes a ship's side or the walls of a fort. Mr. Snyder is now in Washington, consulting with government authorities in regard to his invention, and a test, to be made at Sandy Hook next month, has been agreed upon.

ELECTRICAL PATENTS ISSUED

And Dated June 12, 1883.

Apparatus for measuring electric currents; St. George Lane Fox, London, England	279,371
Armature for dynamo-electric machines; Edward K. Knowles, Brooklyn, N. Y., and Frank E. Idell, Hoboken, N. J	279,399
Combined telephonic and burglar-alarm system; Winfield S. Shoupe, Elyria, and Theodore Buskirk, Toledo, Ohio	279,193
Combined telegraph and clock system; Chas. E. Buell, New Haven, Conn	279,327
Dynamo-electric machine; Nathan H. Edgerton, Philadelphia, Pa	279,362
Dynamo-electric machine; R. Edward Hall, New York, N. Y	279,476
Electric-arc lamp; John H. Guest, Brooklyn, N. Y	279,152
Electric conductor; James Webb Rogers, New York, N. Y	279,189
Electric-light; Joseph H. Chassé, Springfield, Mass	279,224
Electro-magnetic motor for clocks; Heinrich Grau, Cassel, Prussia, Germany	279,239
Electric brush; Joseph N. Aronson, London, England	279,315
Electrical device for protecting wire fences; Charles A. Brainerd, Chicago, Ill	279,322
Electrode for secondary batteries; Norman C. Cookson, Newcastle-upon-Tyne, County of Northumberland, England	279,346
Electric-arc lamp; Nathan H. Edgerton, Philadelphia, Pa	279,363
Electric lamp; Jas. J. Wood, Brooklyn, N. Y...279,472,	279,512
Telegraph and telephone line; Theodore N. Vail, Boston, Mass	279,289
Telephone-transmitter; James A. Lakin, Westfield, Mass	279,401
Underground conduit for electric wires; Wm. H. Johnstone, Philadelphia, Pa	279,392

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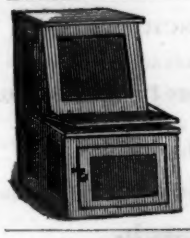

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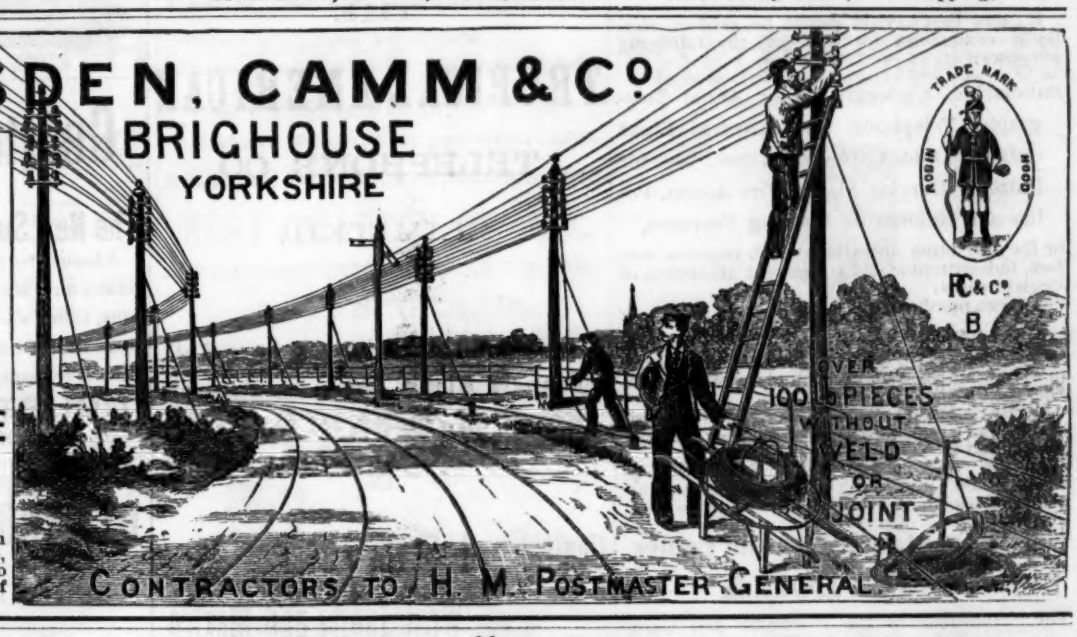

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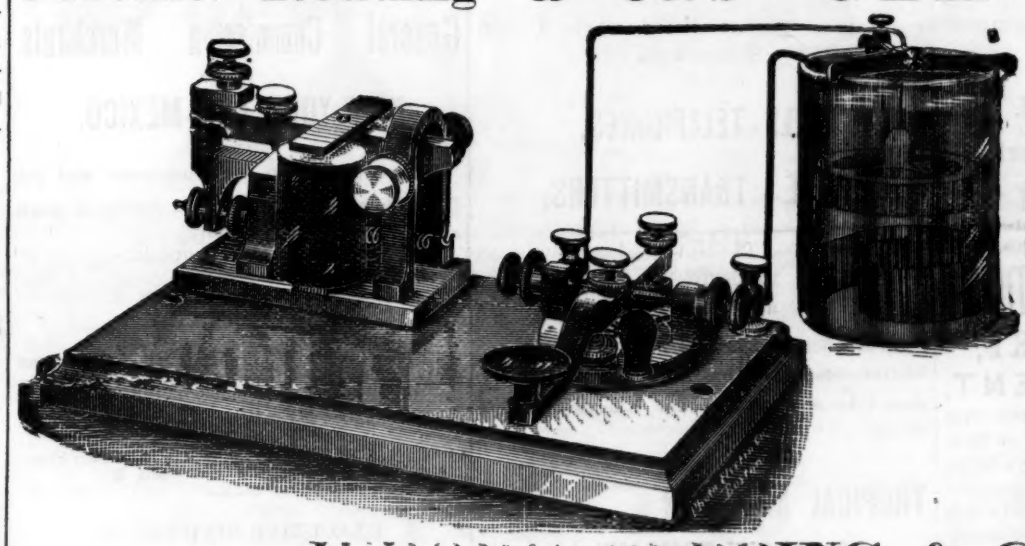

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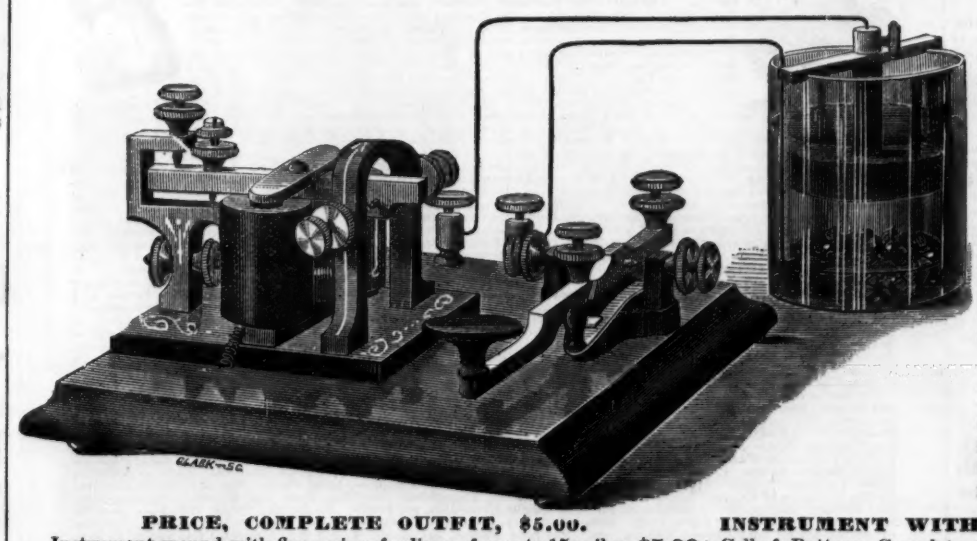

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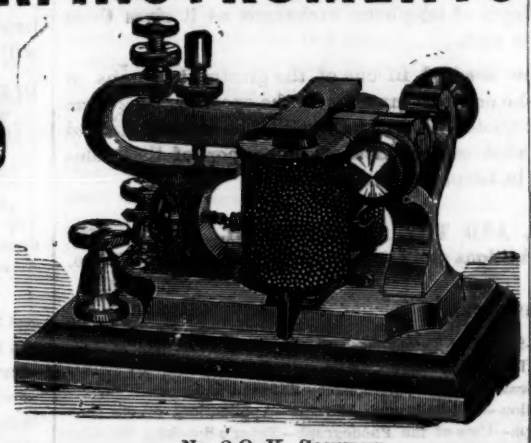

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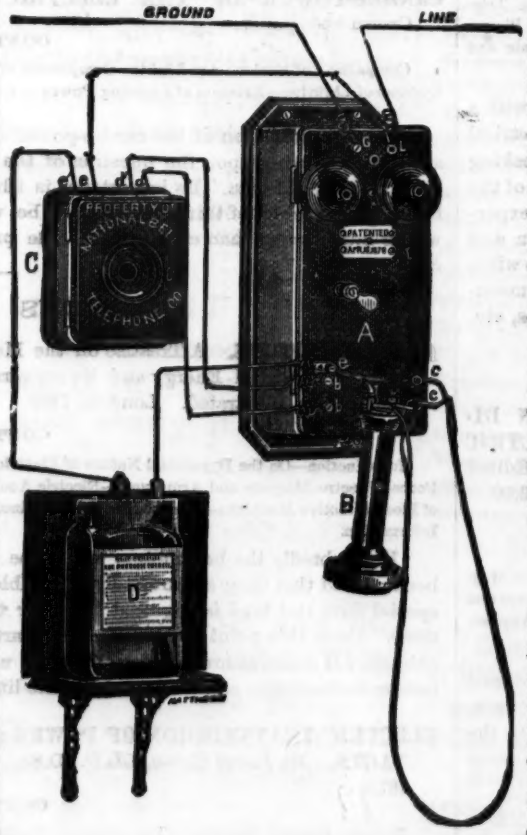

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TELEPHONY.

PRACTICAL INFORMATION FOR TELEPHONISTS. By T. D. LOCKWOOD, Electrician, American Bell Telephone Company. 12mo, cloth. New York, 1882. $1.00.

CONTENTS.

Historical Sketch of Electricity from 600 B. C. to 1882 A. D.—Facts and Figures about the Speaking Telephone—How to Build a Short Telegraph or Telephone Line—The Earth and its Relation to Telephonic Systems of Communication—The Magneto-Telephone; What it is, How it is made, and How it should be handled—The Blake Transmitter—Disturbances Experienced on Telephone Lines—The Telephone Switch-Board—A Chronological Sketch of the Magneto-Bell, and How to Become Acquainted with it—Telephone Transmitter Batteries—Lightning; its Action upon Telephone Apparatus; How to prevent or reduce Troubles Arising therefrom—The Telephone Inspector—The Telephone Inspector; his Daily Work—The Inspector on Detective Duty—The Daily Routine of the Telephone Inspector—Individual Calls for Telephone Lines—Telephone Wires *versus* Electric Light Wires—Electric Bell Construction—Housetop Lines, Pole Lines and Aërial Cables—Anticipations of Great Discoveries and Inventions.

The chapters of which this book is composed were originally published in THE OPERATOR, where they were found so useful to practical telephone men as to induce an imperative demand for their re-publication in the present convenient form. The book, while giving a mass of valuable information, such as could only be acquired by an extended practical experience with the telephone, is written in an easy, chatty style, which makes it entertaining reading. It is the only book that contains a description of the Blake transmitter, now used almost universally throughout the United States. No one who has anything to do with telephones can fail to find in it something of interest or value; but it is particularly useful to the managers and employés of telephone exchanges, as it gives them valuable instruction about every detail of their work.

Professor A. Graham Bell, before his researches resulted in one of the greatest triumphs of modern science. All who believe Bell to be the original inventor of the speaking telephone should have a copy of the work from which to quote. All who believe that he was not, should have one, so as to acquaint themselves with what can be advanced in support of the claims made for Bell. In fact, everybody interested in telephony should read it.

THE TELEPHONE, THE MICROPHONE, AND THE PHONOGRAPH. By COUNT DU MONCEL. Authorized Translation, with Additions and Corrections by the Author. 12mo, cloth, 70 illustrations. $1.25.

CONTENTS.

History of the Telephone—Musical Telephones—Speaking Telephones—Fundamental Principles of Bell Telephone—Battery Telephones—Modification of Bell Telephones—Experiments with the Telephone—Other Experiments with the Telephone—The Microphone—Applications of the Microphone—External Influence on Telephonic Transmissions—Establishment of Telephone Station—Call-Bells and Alarums—Applications of the Telephone—Various Uses of the Telephone—The Phonograph—Uses of the Phonograph—Faber's Speaking Machine—Appendix.

Count Du Moncel's is one of the cheapest books in the market. In his accustomed easy and popular style the author discusses the speaking telephone. Beginning with the Reiss telephone, and giving due place to the musical telephones of Wray, Pollard and Garnier and Varley, and the well-known string telephone, or lovers' telegraph, the magneto telephone of Bell is reached and fully described. After this the respective claims of Gray and Bell are impartially canvassed. The Bell telephone, with its thousand and one modifications, the battery telephone and microphone, with the adaptations of both to oral communication, pass before the reader in turn. A chapter is devoted to disturbances which appear on telephone wires, and another to the phonograph. Those who can only afford one book on the telephone, should make a point of securing this one.

THE SPEAKING TELEPHONE, ELECTRIC LIGHT, AND OTHER RECENT ELECTRICAL INVENTIONS. By GEORGE B. PRESCOTT. 8vo, cloth, 319 illustrations and 1 plate. New York, 1879. $4.00.

CONTENTS.

The Speaking Telephone—Bell's Telephonic Researches—The Telephone Abroad—History of the Production of Galvanic Music—Gray's Telephonic Researches—Edison's Telephonic Researches—Electro-Harmonic Telegraphy—Dolbear's Telephonic Researches—Improvements of Channing, Blake and others—The Talking Phonograph—Quadruplex Telegraphy—Electric Call Bells—The Electric Light—Edison's Recent Telephonic and Acoustic Inventions—Duplex Telegraphs, Electro-Magnets and Electric Time Service.

This is a large and handsome work, the object of which is to furnish the public with a clear and accurate description of the more recent and useful improvements in electrical science, and especially to explain the principles of that marvelous production, the speaking telephone. The most interesting portion of the work, to most readers, is the history of the original telephonic researches of Bell, Gray and Edison, the account of each inventor's experiments being given in his own words. It contains also a very thorough description and explanation of the quadruplex telegraph, with numerous diagrams, showing how the wires are arranged, and gives excellent accounts of the Brush, Maxim, Jablochkoff, Thomson-Houston, and other systems of electric arc lighting, with descriptions of the dynamos, etc. The illustrations throughout the work are very fine.

ELECTRIC LIGHTING.

ELECTRIC LIGHT, ITS PRODUCTION AND ITS USE; EMBODYING PLAIN DIRECTIONS FOR THE WORKING OF GALVANIC BATTERIES, ELECTRIC LAMPS AND DYNAMO-ELECTRIC MACHINES. By J. W. URQUHART, C.E. Edited by F. C. WEBB, M.I.C.E., etc. 8vo, cloth, 94 illustrations. London, 1880. $3.00.

CONTENTS.

Introduction—Voltaic Batteries—Thermo-Electric Batteries—Magneto-Electric Generators—Electro-Magnetic Electric Machines—Dynamo-Electric Machines—General Observations on Machines—Electric Lamps and Candles—Measurement of Electric Light—Mathematical and Experimental Treatment of the Subject—Application and Cost of the Electric Light.

A very convenient and complete treatise on the electric light. The principles are defined in a manner devoid of technicalities, so as to render the book very valuable to the beginner. The history of the dynamo-electric machine and its development, from the Pixii to the Gramme machine, is also quite complete. The recent types of machine receive a full share of attention and the various styles of lamps are treated in full.

ELECTRIC LIGHTING. Translated from the French of LE COMTE TH. DU MONCEL, by ROBERT ROUTLEDGE, B.Sc. Crown 8vo, cloth, 76 illustrations. London, 1882. $1.25.

CONTENTS.

General Considerations—Generators of Electric Light—Electric Lamps—Cost of Electric Lighting—Applications of Electric Light—Conclusion—Notes and Appendices.

A translation of the work of this prolific writer on electrical subjects, published at Paris, in 1880, under the title of "L'Eclairage Electrique," to which the translator has added brief accounts of the apparatus connected with electric lighting which have been brought forth since the publication of the original edition, viz., Swan's, Maxim's, Edison's, and Fox-Lane's incandescent lamps, and the Faure secondary battery. To the student or the general reader who desires information free from abstruse technicalities, and at an insignificant cost, on a subject that is attracting general attention, this work, the original of which is one of a popular science series, can be recommended. The object held constantly in view by the author was to make the treatise thoroughly practical. The book is the cheapest one that aims to cover the whole ground of electric lighting.

ELECTRIC LIGHTING AND ITS PRACTICAL APPLICATION; WITH RESULTS FROM EXISTING EXAMPLES. By J. N. SHOOLBRED. 8vo, cloth, 5 plates. London, 1879. $2.00.

CONTENTS.

Historical and Descriptive—Electric Light Machines—Lamps and Regulators—Carbons; Conducting Wires—Motive Power—Luminous Intensity—Applications; Economic Results—Prospects of Electric Lighting.

A handy little treatise, very valuable to the beginner. The author adopts a popular method of treating the subject and avoids technicalities as much as is compatible with the precision of the work. The history of the early efforts in this field is given, the apparatus being briefly described in each case. The notice of recent inventions, up to the date of print, is quite complete. The questions of power and of photometry form the subjects of very interesting and instructive details.

USEFUL INFORMATION ON ELECTRIC LIGHTING. By KILLINGWORTH HEDGES, M.S.T.E. Fourth Edition, Revised and Enlarged. Crown 8vo, cloth, 20 plates. London, 1883. $1.75.

CONTENTS.

Production of Electricity—Voltaic Arc—Division of the Electric Light—Machines or Generators—Power required, and Motors—Application of the Electric Light—Choice of a System—Setting to Work—Cost of Working—Measurement of Light and Current—Storage of Electricity and Transmission of Power—Electrical Measurement of Work—Useful Memoranda.

The first edition of this work met with so great a success as to encourage the issue of enlarged second and third editions, which have in turn been exhausted. A fourth edition, still further enlarged, has just been issued.

ELECTRIC LIGHTING BY INCANDESCENCE, AND ITS APPLICATION TO INTERIOR ILLUMINATION. A Practical Treatise. By WILLIAM E. SAWYER. 8vo, cloth, 96 illustrations. New York, 1881. $2.50.

CONTENTS.

Introduction—Generators of Electricity—Generators of the Gramme Type—Generators of the new Siemens Type—Incandescent Lamps—Carbons for Incandescent Lighting—New Forms of Lamps—Preservation of Incandescent Carbons—Division of Current and Light—Regulators and Switches—General Distribution—Commercial Aspects.

This book is an indispensable addition to the libraries of all who desire to keep up to the age in the novelty of electric lighting. Its author neglects the arc light altogether, and gives his readers a graphic account of the generators employed in the production of the necessary currents; of those lamps which utilize the currents when generated; of the most advantageous circuit arrangements and apparatus, and of the best materials to use in lighting by incandescence. A historical sketch shows that the idea of electric lighting by incandescence is as old almost as telegraphy itself. The book is handsomely printed and copiously illustrated.

INCANDESCENT ELECTRIC LIGHTS, WITH PARTICULAR REFERENCE TO THE EDISON LAMPS AT THE PARIS EXHIBITION. To which is added The Economy of the Electric Light by Incandescence, by JOHN W. HOWELL; and On the Steadiness of the Electric Current, by C. W. SIEMENS. Illustrated. 18mo, boards. New York, 1882. 50c.

There is no book that contains more valuable information in the same space than this. On the question of incandescent lights it must be considered the best authority at present accessible. The tables and data given help very much in analyzing facts and making comparisons. The article by Mr. C. W. Siemens is especially valuable and interesting. It refers to a new method of exciting the field of dynamo-electric machines, which enables the current to maintain itself constant in the external circuit, no matter how great and rapid the variations of resistance may be. This method has come into use as a most valuable adjunct in the dynamos intended for incandescent lamps, where it enables any of the lamps to be put on and off at will without affecting the rest. For this reason this article is of great interest to every person interested in electric lighting.

CANDLE-POWER OF THE ELECTRIC LIGHT. By PAGET HIGGS, LL.D., D.Sc. Crown 8vo, paper. 25c.

CONTENTS.

Comparison of Various Arc Lights—Comparison of Various Incandescent Lights—Economical Ratio of these Systems of Lighting—Relation of Lighting Power to Quantity of Current—Sources of Loss in Existing Lamps.

The determination of the candle-power of the electric light is a matter of much importance in its bearing upon the question of the comparative economy of electricity and gas as means of illumination. Its importance is illustrated by the fact that the publishers deemed this little pamphlet of thirteen pages to be worth seventy-five cents. The sale of the book was so much larger than expected that the price has recently been reduced to twenty-five cents.

VARIOUS APPLICATIONS.

ELECTRO-MOTORS. A Treatise on the Means and Apparatus employed in the Transmission of Electrical Energy and its conversion into Motive Power. By J. W. URQUHART. 12mo, cloth, illustrated. London, 1882. $3.00.

CONTENTS.

Introduction—On the Dynamical Nature of Electric Currents—Electrical Measurements—Electro-Magnetic Force—Electro-Magnets and Armatures—Electric Accumulators or Magazines—The Construction and Efficiency of Electro-Motive Machines—Electric Railways—Minor Applications of Electro-Motive Energy—Fragmentary Information.

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ELECTRIC TRANSMISSION OF POWER; ITS PRESENT POSITION AND ADVANTAGES. By PAGET HIGGS, LL.D., D.Sc. Crown 8vo, cloth, 21 illustrations. London, 1879. $1.20

CONTENTS.

Dynamo-Electric Machines—The Gramme Machine—The Brush Machine—The Wallace-Farmer and Siemens' Machines—Efficiency of Dynamo-Electric Machines—Practicability of Transmission of Power by Electricity—Efficiency of Coupled Machines—Comparative Efficiency of Various Machines—Other Theoretical Considerations—Conclusions.

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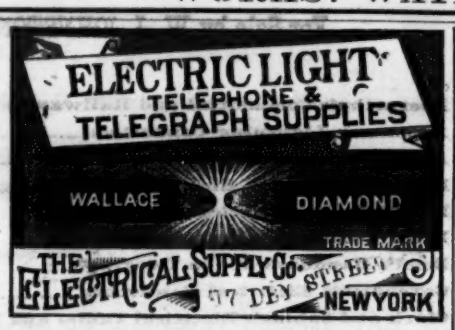

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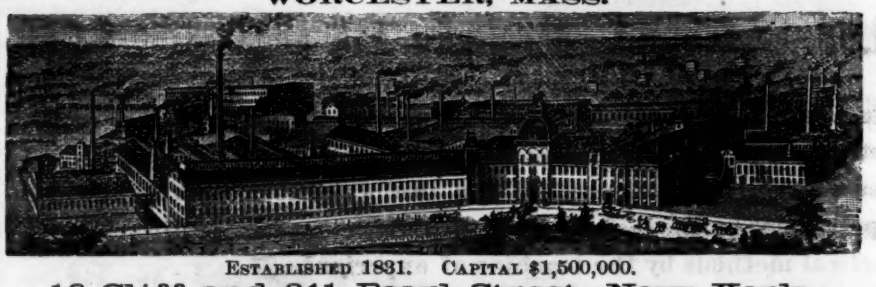

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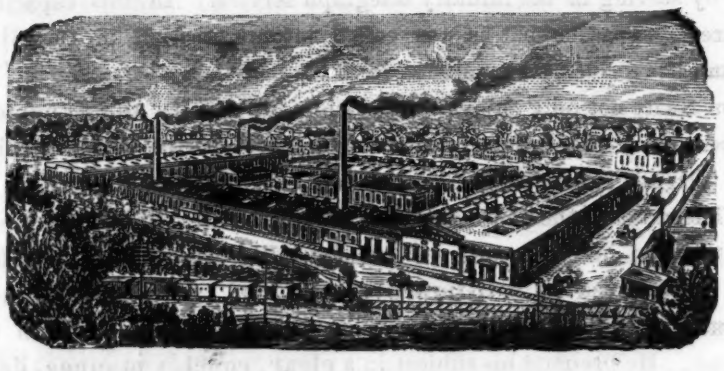

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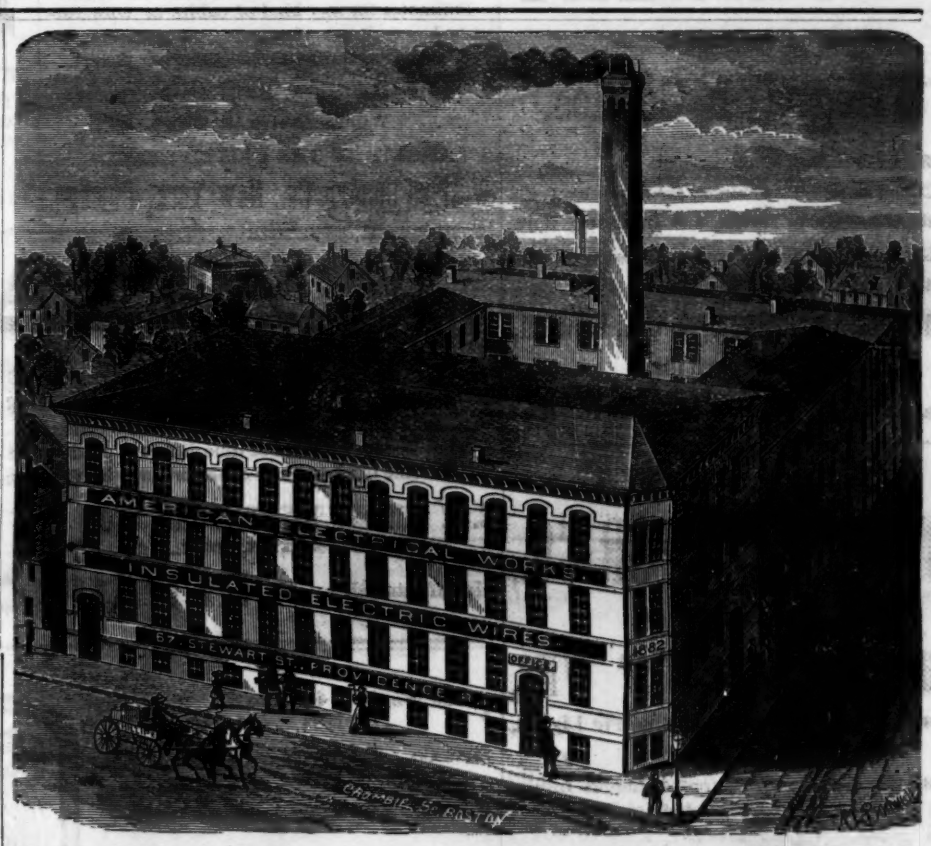

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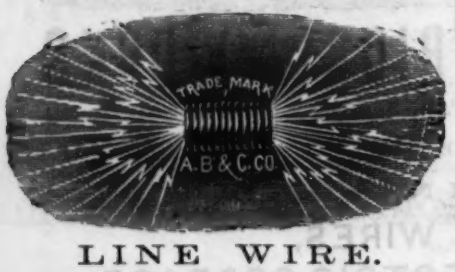

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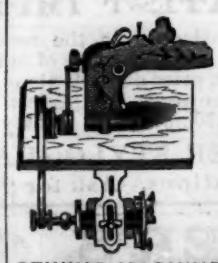

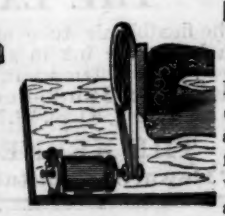

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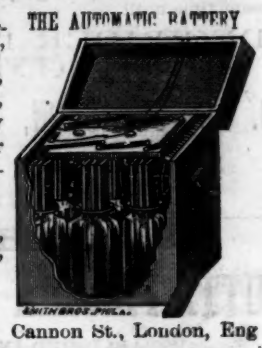

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